Board Information

- **Board of Directors**
  Engineering, Operations, and Technology Committee

7/28/2026 Board Meeting

5a

Subject

Assessment of Direct Potable Reuse Implementation Strategies for Pure Water Southern California

Executive Summary

Pure Water Southern California (PWSC) was originally envisioned to be solely an indirect potable reuse (IPR) program, providing purified water for groundwater recharge and commercial/industrial purposes to offset the use of imported water supplies. As its planning evolved over time and regulations for direct potable reuse (DPR) were promulgated, Metropolitan integrated raw water augmentation (RWA), one form of DPR, into the PWSC planning effort. Metropolitan's Board directed staff to also investigate the potential for the implementation of treated water augmentation (TWA), a different DPR pathway, for its potential cost benefit associated with reduced conveyance requirements. Staff conducted a focused DPR study to address both the RWA and TWA opportunities for a more comprehensive assessment of potential DPR implementation strategies for PWSC. Infrastructure requirements and high-level costs were developed for each potential scenario. The assessment and preliminary findings are summarized in a draft technical memorandum (**Attachment 1**) and will be presented at the workshop.

A DPR demonstration testing facility is planned to evaluate the performance of regulatory-prescribed and other alternative DPR treatment trains for potential full-scale application. A board action to award a contract to construct the recommended facilities is planned for early 2027. The role of the modified demonstration plant in examining the potential use of expanded DPR applications will be discussed at the workshop. The need for additional technical studies, required to address other water quality, hydraulic, and operational issues to further refine the analysis, will also be discussed at the workshop. The draft technical memorandum will be further updated based on feedback from the Board at the workshop, member agency input, and review by Metropolitan's independent science advisory panel for PWSC.

Fiscal Impact

None

Applicable Policy

Not applicable

Related Board Action(s)/Future Action(s)

Early 2027 – Authorize a Construction Manager/General Contractor (CM/GC) alternative project delivery agreement for PWSC's DPR Testing Facility

Details and Background

Background

PWSC is a collaboration between the Metropolitan Water District of Southern California (Metropolitan) and the Los Angeles County Sanitation Districts (Sanitation Districts) to beneficially reuse up to 150 million gallons per day (MGD) of purified water, produced from a new Advanced Water Purification Facility (AWPF) at the Sanitation Districts' A.K. Warren Water Resource Facility for IPR and DPR applications. PWSC is envisioned to be implemented in a phased approach. A focused study was conducted to evaluate potential strategies for implementing DPR via RWA and/or TWA as part of PWSC.

In September 2024, Metropolitan published a white paper, *Roadmap for Direct Potable Reuse: Considerations for Implementing DPR through the Pure Water Southern California Program*. This paper presented an overview of considerations for DPR implementation, summarized regulatory requirements, stated the research needs, and explained the benefits and challenges associated with both RWA and TWA. Furthermore, it recommended refining the planning efforts as PWSC becomes more defined.

DPR offers an opportunity to enhance Metropolitan's water supply portfolio while providing additional water system resiliency and reliability. Although RWA has been incorporated into PWSC's Phase 1 planning, Metropolitan's Board has requested that staff also explore TWA options along the proposed backbone pipeline, which potentially could eliminate extended conveyance to Metropolitan's F.E. Weymouth Water Treatment Plant (Weymouth plant) and potentially reduce capital costs, as well as operations and maintenance costs. The backbone pipeline is planned to extend as far north as the Main San Gabriel Basin.

The DPR implementation strategies aim to optimize PWSC infrastructure and operations, enhance local water supply reliability and operational flexibility, ensure high-quality water, and reduce overall implementation costs. This document outlines potential DPR implementation scenarios, including demand projections, alternative DPR treatment locations, key water quality considerations related to integration with the existing distribution system, possible DPR connections along Metropolitan's existing feeders, assessments of necessary infrastructure improvements, rough-order-magnitude cost estimates, potential benefits of the varied forms of DPR, and recommended additional technical studies. These conceptual DPR implementation scenarios and associated cost estimates have been developed based on current PWSC information and assumptions. The DPR implementation assessment will be refined and investigated further through targeted technical studies, DPR demonstration testing, and additional cost-benefit analysis.

Demand Assumptions. Potential PWSC IPR and DPR demands have been identified in the technical memorandum and are based on Metropolitan's operational model, which incorporates hydrologic factors, supply conditions, recharge availability, and special circumstances, including seismic and emergency events, and the implementation of water supply allocation plans. A Monte Carlo demand simulation model was used, encompassing hydrologic conditions from 2000 to 2024. These demands will be refined further with the development of member agency term sheets/agreements.

The median IPR demand was previously estimated to be 90 MGD. In this study, the estimated IPR demands are slightly higher. In addition, IPR demands are prioritized to maximize deliveries to the member agency partners. The RWA capacity for PWSC Phase 1 was set at 25 MGD, which is the estimated capacity of the existing Azusa Pipeline, if it is repurposed and retrofitted to convey purified water to the Weymouth plant. The RWA capacity for PWSC Phase 2 was established at 60 MGD to achieve the overall PWSC capacity goal of 150 MGD. A new conveyance pipeline would be sized accordingly to serve this RWA demand.

The TWA demands used in this study considered various Central Pool feeders, the minimum sustainable flow for the water treatment plants, and the maximum flow that the feeders could accept from new sources. Ultimately, the TWA flows would offset feeder demands while allowing each treatment plant to operate above its minimum sustainable flow and not exceed feeder capacities.

Considering the seasonal limitations with respect to the availability of the spreading basins for IPR application, DPR integration would allow Metropolitan to maximize AWPF's online factor throughout the year for sustained revenue generation. Further investigations, aimed at evaluating hydraulic and operational impacts, as well as water quality considerations, will be conducted for each of the TWA scenarios. Selection of a preferred alternative will require a more comprehensive evaluation of system operations and water quality implications associated with introducing additional water into the Central Pool of Metropolitan's treated water distribution system.

DPR Scenarios. Four primary DPR scenarios were evaluated in the technical memorandum. Scenario 1 is the baseline scenario and considers RWA for both Weymouth and Diemer; Scenario 2 considers a TWA connection at the Weymouth Finished Water Reservoir; and Scenario 3 includes three TWA demand subsets supplying Metropolitan's Central Pool from a satellite DPR treatment facility. Scenarios 1, 2, and 3 employ an alternative treatment train to meet DPR demands. Scenario 4 evaluates three similar TWA demand subsets in which water would be treated and conveyed directly from the AWPF to the Central Pool through either single or dual pipelines, using regulatory-prescribed or alternative DPR treatment trains, with either combined or separate DPR and IPR treatment. After careful evaluation of Scenario 2, it was decided that it would no longer be studied, and the study will continue with the remaining scenarios.

The required treatment and conveyance infrastructure, rough order of magnitude (ROM) life-cycle costs, and potential implementation challenges for each scenario were developed. As further technical studies are completed, the cost estimates will be refined. The results are intended to establish a high-level financial basis for scenario screening and strategic planning.

Maximum Achievable DPR via TWA. For the purposes of the technical memorandum, staff developed four DPR scenarios for assessment. The baseline alternative (Scenario 1) considers implementing RWA at the Weymouth plant and serves as the basis for comparison with the other DPR scenarios. The remaining three scenarios would implement TWA via direct injection of the purified water into Metropolitan treated water feeders. The analysis indicated that the TWA capacity is influenced by minimum imported water flows, year-round treated water demand, and feeder capacity. Based on these factors, the maximum TWA (Scenarios 3 and 4) is estimated at 75 MGD (median) and up to 100 MGD (seasonal peak).

Potential for Reducing the Conveyance Pipeline Size and Length. The baseline scenario includes approximately 39 miles of large-diameter backbone pipeline to convey up to 150 MGD to IPR connections, and ultimately to the Weymouth plant (via smaller-diameter DPR conveyance systems), resulting in significant conveyance capital and life-cycle costs. Implementing Scenarios 3 and 4 would shift a substantial portion of flow to TWA applications along feeders in Metropolitan's Central Pool area, reducing IPR demand, shortening the backbone pipeline to the Santa Fe Spreading Grounds (37.4 miles), and eliminating the Weymouth plant connection and the new DPR pipeline (12 miles).

Scenario 3 would utilize the Second Lower Feeder (SLF) for TWA with a satellite facility to treat purified water to DPR standards. To accommodate Reverse Osmosis (RO) concentrate, the backbone pipeline would be upsized over a 4.3-mile segment. The downstream backbone pipeline could be downsized to 66 inches in diameter over a 1.6-mile segment, then to 54 inches for 31.5 miles. The dedicated DPR pipeline to Weymouth could be eliminated. These modifications could reduce PWSC capital costs, inclusive of the satellite facility; however, additional advanced treatment processes at multiple locations (i.e., AWPF and satellite facility) would result in higher annual O&M costs. It should be emphasized that all cost estimates in the draft technical memorandum are ROM, and the analysis is at a high level. While some cost contingencies were included to account for unknowns, these analyses must be further refined with additional studies to provide an accurate comparison with the baseline scenario.

Under Scenario 4, the SLF would also be utilized for TWA, but treatment for DPR would take place at the AWPF. The length of the 84-inch-diameter backbone pipeline would be reduced from 37.4 miles (baseline) to about four miles, with most of the remaining pipe sized for 54 inches in diameter. Similar to Scenario 3, the Weymouth connection would be eliminated, yielding potential capital cost savings. Furthermore, centralizing treatment at the AWPF would provide notable reductions in annual O&M and overall life-cycle costs.

Other Cost Analyses. An in-depth evaluation was performed to identify cost-effective approaches for managing nitrate and boron, two key water quality constituents for PWSC. Use of existing engineered buffers was assessed to improve system reliability and provide regulatory compliance benefits, while additional investigations are needed for the addition of engineered buffers at TWA connection points. Conveyance system flexibility was evaluated through pipeline sizing to accommodate demand variability and enable future expansion.

The cost analysis reinforced the value of limiting the number of treatment trains, treatment sites, and associated conveyance infrastructure to ultimately deliver 150 MGD for PWSC's IPR and DPR applications. Scenario 4, featuring a single treatment train and a single pipeline, shows a potentially feasible DPR implementation strategy that could be further developed. However, all scenarios could be refined with feedback from member agencies, PWSC's independent science advisory panel, and other stakeholders.

RWA and TWA Benefits. RWA and TWA present different advantages and considerations. Implementing DPR through RWA provides broader systemwide flexibility. RWA allows advanced treated water to reach a wider service area through distribution from Weymouth and Diemer, promotes more consistent water quality across the region, and supports regional reductions in constituents such as TDS. This option also leverages existing conveyance detention time and treatment barriers, enhancing optimal hydraulic distribution and protection against unknown constituents. This approach builds on established operational expertise, monitoring, and response systems. Additionally, RWA has minimal impact on water age and the existing treated water distribution system.

On the other hand, implementing DPR through TWA has the potential to reduce the need for additional conveyance infrastructure and lower associated pumping energy. This option also eliminates the need to assess blending impacts on existing water treatment plants and reduces DPR-related changes to treatment plant monitoring, reporting, and operational plans. While TWA offers several potential benefits, further evaluation is needed to better understand its operational and water-quality impacts on the treated water distribution system. These impacts will be evaluated through the planned DPR pilot and demonstration testing.

Preliminary Findings. The technical memorandum outlines staff's preliminary finding that DPR integration would offer key benefits, including greater flexibility in using purified water, improved system resilience during emergencies, and enhanced reliability under drought conditions. The assessment has confirmed that DPR implementation via RWA and TWA would be feasible, with opportunities to optimize treatment, backbone pipeline sizing, and system configuration as needed to reduce overall costs while maintaining reliability and high-quality water service.

Technical Studies. It is important to note that while challenges have been identified at a high level, they have not been fully explored. Additional technical studies related to water quality, public acceptance, and operational and hydraulic performance are being planned to address challenges associated with implementing DPR, particularly through TWA. These studies are needed to evaluate potential operational and water quality impacts on the distribution system, optimize treatment performance, and ensure regulatory objectives are met.

Public Outreach/Acceptance. Public outreach and public acceptance are important components of the DPR demonstration testing and implementation planning process. During operation of the DPR demonstration facility, outreach efforts will help communities, partners, and other interested parties better understand how DPR would serve as a new, high-quality water supply, including the differences between RWA and TWA, the treatment processes, monitoring requirements and regulatory oversight. These efforts would build on PWSC's existing outreach foundation and expand opportunities to evaluate public understanding and confidence. Continued community outreach will help foster a well-informed and supportive public, essential for the successful implementation of DPR.

Next Steps. If a particular scenario emerges as the preferred option, it will be addressed in greater detail through future targeted studies and technical evaluations. All scenarios will be refined based on feedback from the Board, member agencies and PWSC's independent scientific advisory panel. Identifying opportunities and synergies among the various scenarios will be essential for effective long-term planning. Leveraging these factors can help achieve significant capital and operational cost savings, making them critical considerations in the decision-making process. Staff recommends proceeding with the DPR testing facility, as this facility would serve as a valuable tool to verify the performance of DPR treatment trains, address other water quality considerations, and optimize the treatment process, potentially reducing overall program costs.

Project Milestones

Award contract for construction of DPR facilities at Metropolitan's existing Pure Water demonstration plant – early 2027

Completion of demonstration testing for alternative DPR treatment trains – end of 2030

7/20/2026

Mai M. Hattar
Chief Engineer
Engineering Services
Date

7/20/2026

Shivaji Deshmukh
General Manager
Date

Attachment 1 – Draft Technical Memorandum, Assessment of DPR Implementation Strategies

Ref# es12710319

DRAFT TECHNICAL MEMORANDUM

Pure Water Southern California
Assessment of DPR Implementation Strategies
July 2026

Prepared for: The Metropolitan Water District of Southern California
Project Title: Pure Water Southern California
Prepared by: AECOM BC Team (including Trussell Technologies)

Executive Summary

The purpose of this technical memorandum is to evaluate potential strategies for implementing direct potable reuse (DPR) via raw water augmentation (RWA) and/or treated water augmentation (TWA) as part of Pure Water Southern California (PWSC). PWSC is a collaboration between the Metropolitan Water District of Southern California (Metropolitan) and the Los Angeles County Sanitation Districts (Sanitation Districts) to beneficially reuse up to 150 million gallons per day (MGD) of purified water, produced from a new Advanced Water Purification Facility (AWPF) at the Sanitation Districts' A.K. Warren Water Resource Facility (Warren Facility) for indirect potable reuse (IPR) and DPR applications. PWSC is envisioned to be implemented in a phased approach.

DPR White Paper. In September 2024, Metropolitan published a white paper, *Roadmap for Direct Potable Reuse: Considerations for Implementing DPR through the Pure Water Southern California Program*. This paper presented an overview of considerations for DPR implementation; summarized regulatory requirements, stated the research needs, and explained the benefits and challenges associated with both RWA and TWA. Furthermore, it recommended refining the planning efforts as PWSC becomes more defined.

Purpose. DPR offers an opportunity to enhance Metropolitan's water supply portfolio while providing additional water system resiliency and reliability. Although RWA has been incorporated into PWSC's Phase 1 planning, Metropolitan's Board has requested that staff also explore TWA options along the proposed backbone pipeline, which potentially could eliminate extended conveyance to Metropolitan's F.E. Weymouth Water Treatment Plant (Weymouth plant) and substantially reduce capital costs as well as operations and maintenance costs. Currently, the backbone pipeline is planned to be constructed as far north as Main San Gabriel Basin.

Approach. The DPR implementation strategies aim to optimize PWSC infrastructure and operations, enhance local water supply reliability and operational flexibility, and reduce the overall implementation costs. This document outlines potential DPR implementation scenarios, including demand projections, alternative DPR treatment locations, key water quality considerations related to integration with the existing distribution system, possible DPR connections along Metropolitan's existing feeders, assessments of necessary infrastructure improvements, rough-order-magnitude cost estimates, potential benefits, and recommended additional technical studies. These conceptual DPR implementation scenarios and associated cost estimates have been developed based on current PWSC information and assumptions. The DPR implementation assessment will be refined and investigated further through targeted technical studies, DPR demonstration testing, and additional cost-benefit analysis.

Demand Assumptions. PWSC's potential IPR and DPR demands have been estimated based on Metropolitan's operational model, which incorporates hydrologic factors, supply conditions, recharge availability, and special circumstances, including seismic and emergency events, and the implementation of water supply allocation plans. A Monte Carlo demand simulation model was used, encompassing hydrologic conditions from 2000 to 2024. These demands will be refined further with the development of member agency term sheets/agreements.

The median IPR demand was previously estimated to be 90 MGD. In this study, the estimated IPR demands are slightly higher. In addition, IPR demands are prioritized to maximize deliveries to the member agency partners.

The RWA capacity for PWSC Phase 1 was set at 25 MGD, which is the estimated capacity of the existing Azusa pipeline, if it is repurposed and retrofitted to convey purified water to the Weymouth plant. The RWA capacity for PWSC Phase 2 was established at 60 MGD to achieve the overall PWSC capacity goal of 150 MGD. A new conveyance pipeline would be sized accordingly to serve this RWA demand.

The TWA demands used in this study considered various Central Pool feeders, the minimum sustainable flow for the water treatment plants, and the maximum flow that the feeders could accept from new sources. Ultimately, the TWA flows would offset feeder demands while allowing each treatment plant to operate above its minimum sustainable flow and not exceed feeder capacities.

Considering the seasonal limitations with respect to the availability of the spreading basins for IPR application, DPR integration would allow Metropolitan to maximize the AWPF's online factor[1] throughout the year for sustained revenue generation. Further investigations, aimed at evaluating operational impacts and water quality considerations, will be conducted for each of the TWA scenarios. Selection of a preferred alternative will require a more thorough evaluation and analysis of operational and water quality issues that may exist in various locations within the system.

DPR Scenarios. Figure ES-1 shows the three primary DPR scenarios that are discussed in this document. Scenario 1 considers RWA for both Weymouth and Diemer. Scenario 3 includes three TWA demand subsets supplying Metropolitan's Central Pool from a satellite DPR treatment facility. Scenarios 1 and 3 employ an alternative treatment train to meet DPR demands. Scenario 4 evaluates three similar TWA demand subsets in which water would be treated and conveyed directly to the Central Pool from the AWPF through either single or dual pipelines, using default or alternative DPR treatment trains, with either combined or separate DPR and IPR treatment. Additionally, this TM evaluated a TWA connection at the Weymouth Finished Water Reservoir under Scenario 2; after preliminary discussions, it was determined that it could be excluded from this executive summary.

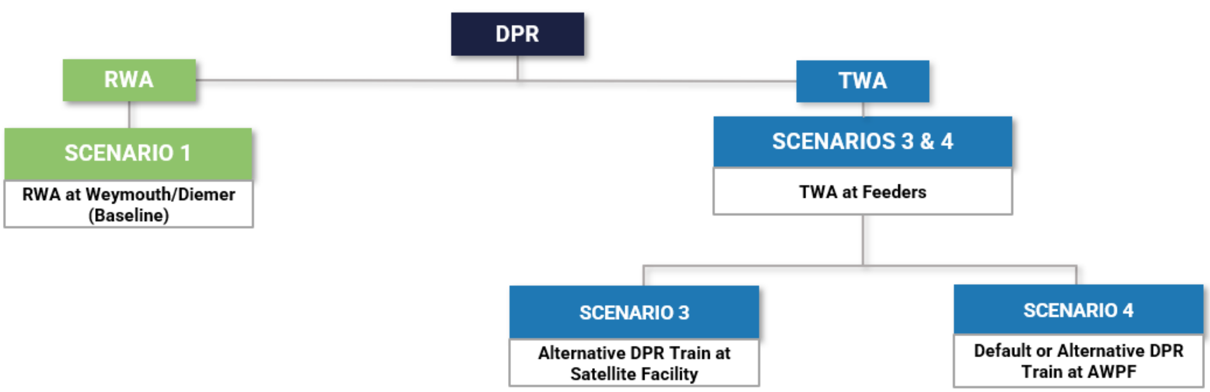

Figure ES-1 Potential DPR Implementation Scenarios

Report Organization. Section 1 provides background information; Section 2 presents an overview of DPR and its treatment requirements; Section 3 assesses Metropolitan's existing infrastructure for DPR use; Section 4 projects the DPR demands; Section 5 establishes the potential DPR implementation scenarios; Section 6 evaluated these scenarios; Section 7 presents the detailed cost

[1] The online factor (as a percentage) reflects the probability of achieving the target production of 150 MGD.

analysis; Section 8 summarizes the key findings of the study; Section 9 identifies the additional study needs to advance DPR planning; and Section 10 summarizes the required treatment and conveyance infrastructure, rough-order-of-magnitude (ROM) life-cycle costs, and potential implementation challenges for each scenario. As PWSC advances, the cost estimates may be refined. The methodology used in developing the ROM unit cost estimates is provided in Attachment A. The results are intended to establish a high-level financial basis for scenario screening and strategic planning.

Preliminary Findings. DPR integration would offer key benefits, including greater flexibility in using purified water, improved system resilience during emergencies, and enhanced reliability under drought conditions. The assessment has confirmed that DPR implementation via RWA and TWA would be feasible, with opportunities to optimize treatment, backbone pipeline sizing, and system configuration as needed to reduce overall costs while maintaining reliability and high- quality water service.

Maximum Achievable DPR via TWA. The baseline (Scenario 1) considers implementing RWA at the Weymouth plant, while Scenarios 2 through 4 would implement TWA via Metropolitan feeders. The analysis indicated that the TWA capacity is influenced by minimum imported water flows, year-round treated water demand, and feeder capacity. Based on these factors, the maximum TWA (Scenarios 3 and 4) is estimated at 75 MGD (median) and up to 100MGD (seasonal peak), as shown in **Table ES-1**. When TWA is maximized, IPR demand would be capped at 75 MGD, enabling termination at the Santa Fe Spreading Grounds instead of the Canyon Spreading Grounds.

Table ES-1: Maximum Attainable DPR via TWA

	Maximum Attainable DPR[1] via TWA under Scenarios 3 and 4
Seasonal Maximum DPR Flow	100 MGD
Median DPR Flow	75 MGD
IPR Flow Cap	75 MGD
IPR Termination Point	Santa Fe Spreading Grounds

[1]Online factor 92% or above; 150 MGD PWSC (Median TWA + IPR Flow Cap); WTP Minimum Sustainable Flows are met; Nitrate and boron targets are met

Potential for Reducing the Conveyance Pipeline Size and Length. The baseline scenario includes approximately 39 miles of large diameter backbone pipeline to convey up to 150 MGD to IPR connections, and ultimately to the Weymouth plant (via smaller diameter DPR conveyance systems), resulting in significant conveyance capital and life-cycle costs. Implementing Scenarios 3 and 4 would shift a substantial portion of flow to TWA applications along feeders in Metropolitan's Central Pool area, reducing IPR demand, shortening the backbone pipeline to the Santa Fe Spreading Grounds (37.4 miles), and eliminating the Weymouth plant connection and the new DPR pipeline (12 miles). A comparison of the baseline and Scenarios 3 and 4 is shown in **Table ES-2**.

Table ES-2: Potential Conveyance Pipeline Size and Length Reduction[1]

	Scenario 1: RWA at Weymouth via Satellite Facility (Baseline)		Scenario 3: TWA at Central Pool via Satellite Facility		Scenario 4: TWA at Central Pool via AWPF	
Seasonal Maximum DPR Flow	60 MGD		100 MGD		100 MGD	
Median DPR Flow	45 MGD		75 MGD		75 MGD	
IPR Flow Cap	105 MGD		75 MGD		75 MGD	
Backbone pipeline (size and length)	84”	37.4 mi	90”	4.3 mi	84”	4.3 mi
	48”	1.7 mi	66”	1.6 mi	66”	1.6 mi
			54”	31.5 mi	54”	31.5 mi
DPR Pipeline (size and length)	54”	12 mi	DPR Pipeline is Eliminated			
Baseline/Relative Capital Cost	$10.1B		-12%		-13%	
Baseline/Relative O&M Cost	$310M		+6%		-10%	
Baseline/Relative Unit Cost	$5,560/AF		-3%		-10%	

Notes: (1) AF = acre-feet; B = billion; DPR = direct potable reuse; IPR = indirect potable reuse; M = million; mi = miles; Relative cost value assesses the difference compared to Scenario 1A (PWSC Phase 1 Baseline).

Scenario 3 would utilize the Second Lower Feeder (SLF) for TWA with a satellite facility to treat purified water to DPR standards. To accommodate TWA satellite feed flow requirements, the backbone pipeline would be upsized over a 4.3-mile segment. The downstream backbone pipeline could be downsized to 66 inches in diameter over a 1.6-mile segment, then to 54 inches for 31.5 miles and the dedicated DPR pipeline to Weymouth would be eliminated. These modifications would reduce PWSC capital costs by approximately $1.2 billion, inclusive of the satellite facility; however, additional advanced treatment processes at multiple locations (i.e., AWPF and satellite facility) would result in higher annual O&M costs. It should be emphasized that all estimates are rough order of magnitude, and the analysis is at a high level. Some contingencies were included to account for unknowns, but these analyses need to be refined with additional studies.

Under Scenario 4, the SLF would also be utilized for TWA, but treatment for DPR would take place at the AWPF. The length of the 84-inch-diameter backbone pipeline would be reduced from 37.4 miles (baseline) to 4.3 miles, with most of the remaining pipe sized for 54 inches in diameter. Similar to Scenario 3, the Weymouth connection would be eliminated, yielding significant capital cost savings. Furthermore, centralizing treatment at the AWPF would provide notable reductions in annual O&M and overall life-cycle costs.

Balancing DPR and IPR Demands. Maximizing TWA at the feeders would reduce IPR projected delivery, requiring IPR to be capped at 75 MGD when DPR reaches 75 MGD (median) and 100 MGD (seasonal peak). The alternative balancing options (Table ES-3) show that lower DPR levels would allow higher IPR capacity: at optimum DPR (45 MGD median), IPR could increase to 105 MGD, while at minimum DPR (35 MGD median), IPR would remain consistent with the baseline scenario. The ROM cost estimates that are shown in Table ES-3 indicate that substantial life-cycle cost savings would be achievable, even without fully maximizing TWA.

Table ES-3: Balancing DPR and IPR Demands[1]

	Baseline	HIGH TWA	MED TWA	LOW TWA
	RWA at Weymouth via Satellite Facility (Scenario 1A)	Highest Possible TWA via Satellite Facility (Scenario 3A)	Medium TWA via Satellite Facility (Scenario 3C)	Lowest Required TWA via Satellite Facility (Scenario 3B)
Seasonal Maximum RWA/TWA Flow	60 MGD	100 MGD	60 MGD	50 MGD
Median RWA/TWA Flow	45 MGD	75 MGD	45 MGD	35 MGD
Maximum IPR Flow	105 MGD	75 MGD	105 MGD	115 MGD
Baseline/Relative Capital Cost	$10.1B	-12%	-14%	-14%
Baseline/Relative O&M Cost	$310M	+6%	-3%	-3%
Baseline/Relative Unit Cost	$5,560/AF	-3%	-7%	-9%

Notes: (1) 150 MGD PWSC; Online factor is 92%; IPR termination point for Scenarios 2,3, and 4 is Santa Fe Spreading Grounds. Relative cost value assesses the difference compared to Scenario 1A (PWSC Phase 1 Baseline).

Furthermore, an in-depth evaluation was performed to identify cost-effective approaches for managing nitrate and boron. Use of existing engineered buffers was assessed to improve system reliability and provide regulatory compliance benefits. Conveyance system flexibility was evaluated through pipeline sizing to accommodate demand variability and enable future expansion.

The cost analysis reinforced the value of limiting the number of treatment trains, treatment sites, and associated conveyance infrastructure, to ultimately deliver 150 MGD for PWSC's IPR and DPR applications. Scenario 4, featuring a single treatment train and a single pipeline, shows a potentially feasible DPR implementation strategy that could be further developed. However, all scenarios could be refined with feedback from member agencies and other stakeholders.

RWA and TWA Benefits. Both RWA and TWA present different advantages and considerations. Implementing DPR through RWA provides broader systemwide flexibility. It allows advanced treated water to reach a wider service area, promotes more consistent water quality across the region, and supports regional reductions in constituents such as TDS. This option also leverages existing conveyance detention time and treatment barriers, enhancing optimal hydraulic distribution and protection against unknown constituents. This approach builds on established operational expertise, monitoring, and response systems. Additionally, raw water augmentation has minimal impact on detention time and the existing treated water distribution system.

On the other hand, implementing DPR through TWA has the potential to reduce the need for additional conveyance infrastructure and lower associated pumping energy. This option also eliminates the need to assess blending impacts on existing WTPs and reduces DPR-related changes to WTP monitoring, reporting, and operational plans. While TWA presents several potential benefits, additional evaluation is needed to better understand its impacts on the treated water distribution system. These impacts will be evaluated through the DPR pilot and demonstration testing.

Technical Studies. It is important to note that while challenges have been identified at a high level, they are not fully explored in this TM. Additional technical studies related to water quality, public acceptance, and hydraulic performance are being planned to address challenges associated with implementing DPR, particularly through TWA. These studies are needed to evaluate potential water quality impacts on the distribution system, optimize treatment performance, and obtain regulatory approvals.

Public Outreach/Acceptance. Public outreach and public acceptance are important components of the DPR demonstration testing and implementation planning process. During operation of the DPR Demonstration Facility, outreach efforts would help communities, partners, and other interested parties better understand how DPR would work, including the differences between RWA and TWA, the treatment processes, monitoring requirements and regulatory oversight. A potential DPR tasting station could further strengthen public confidence and acceptance. These efforts would build on PWSC's existing outreach foundation and expand opportunities to evaluate public understanding, address questions, and strengthen confidence. Continued community outreach will help foster a well-informed and supportive public, essential for the successful implementation of DPR.

If a particular scenario emerges as the preferred option, these challenges can be addressed in greater detail through future targeted studies and technical evaluations. Finally, identifying opportunities and synergies plays a critical role in long-term planning. Leveraging these factors could lead to significant capital and operational cost savings, making them essential considerations in the decision-making process.

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PUREWATER SOUTHERN CALIFORNIA

Attachments

Attachment A: ROM Cost Estimate Details

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Acronyms and Abbreviations

%	percent
AF	acre-feet
AOP	advanced oxidation process
ATW	advanced treated water
AWPF	Advanced Water Purification Facility
AWT	advanced water treatment
BAC	biologically activated carbon
CP	Central Pool
CRA	Colorado River Aqueduct
DDW	Division of Drinking Water
Diemer plant	Robert B. Diemer Water Treatment Plant
DPR	direct potable reuse
EQ	Equalization
ES	Executive Summary
fps	feet per second
FWR	Finished Water Reservoir
GAC	granular activated carbon
Garvey	Garvey Reservoir
GWR	groundwater replenishment
IPR	indirect potable reuse
IQR	interquartile range
JTAP	Joint Water Pollution Control Plant Technical Analysis Project
LF	Lower Feeder
LRV	log reduction value
MBR	membrane bioreactor
Metropolitan	Metropolitan Water District of Southern California
MF	membrane filtration
MF	Middle Feeder
MGD	million gallons per day
O&M	operations and maintenance
PCCP	prestressed concrete cylinder pipes
PCS	Pressure Control Structure
PS	pump station
PVF	Palos Verdes Feeder
PVR	Palos Verdes Reservoir
PWSC	Pure Water Southern California
RO	reverse osmosis
ROM	rough-order-of-magnitude
RWA	raw water augmentation
Sanitation Districts	Los Angeles County Sanitation Districts
SBDDW-23-001	Direct Potable Reuse Regulations
SC	service connection
SLF	Second Lower Feeder
SGVMWD	San Gabriel Valley Municipal Water District
SWP	State Water Project
SWTP	surface water treatment plant
TDS	total dissolved solids
TWA	treated water augmentation
UV	ultraviolet

UV/AOP	ultraviolet/advanced oxidation process
VXF	Victoria Cross Feeder
Warren Facility	A.K. Warren Water Resource Facility
Weymouth plant	F.E. Weymouth Water Treatment Plant
WSE	water surface elevation
WTP	water treatment plant
WWTP	wastewater treatment plant

Section 1: Background

Pure Water Southern California (PWSC) is a proposed partnership between the Metropolitan Water District of Southern California (Metropolitan) and the Los Angeles County Sanitation Districts (Sanitation Districts) to beneficially reuse treated wastewater that is being discharged to the Pacific Ocean from the Sanitation Districts' A.K. Warren Water Resource Facility (Warren Facility) in the city of Carson. A new Advanced Water Purification Facility (AWPF) would be constructed adjacent to the Warren Facility to produce up to 150 million gallons per day (MGD) of purified water for indirect potable reuse (IPR), direct potable reuse (DPR), and non-potable industrial usage.

PWSC is envisioned to be implemented in a phased approach. Phase 1 would include the design, construction, and operation of a new AWPF to produce up to 115 MGD of purified water for IPR applications, of which 25 MGD would be conveyed through San Gabriel Valley Municipal Water District's (SGVMWD's) existing Azusa Pipeline to Metropolitan's F.E. Weymouth Water Treatment Plant (Weymouth plant or Weymouth) for DPR via raw water augmentation (RWA). Phase 2 would include an expansion of the DPR treatment facilities at the Weymouth Plant by an additional 35 MGD and a new pipeline and pump station to convey additional water to the Weymouth Plant for RWA. In addition, Phase 2 would also include a new DPR pump station and pipeline from the Santa Fe Spreading area to the Weymouth Plant. Phase 1 and Phase 2 together form PWSC's total anticipated capacity of up to 150 MGD. Metropolitan is also evaluating opportunities for an initial stage delivery as a subset of Phase 1, which will be determined later this year.

Metropolitan's Board has requested that staff explore treated water augmentation (TWA) options along the proposed backbone pipeline alignment that could potentially eliminate extended conveyance to the Weymouth plant for RWA application and additional pump stations, and optimize the backbone pipeline, which would significantly reduce capital and operations and maintenance (O&M) costs. Currently, the backbone pipeline is planned to be constructed as far north as Main San Gabriel. DPR offers an opportunity to enhance Metropolitan's water supply portfolio while providing additional water system resiliency and robustness. The objective of this technical memorandum (TM) is to develop an approach for optimal integration of DPR applications into Metropolitan's water system, including a comprehensive assessment of potential DPR demands and implementation scenarios, with rough-order-of-magnitude (ROM) cost estimates for shortlisted scenarios. This TM evaluates various DPR planning scenarios for both RWA and TWA, with the associated infrastructure (treatment and conveyance) requirements and total lifecycle cost-benefit analysis. DPR scenarios presented in this TM are conceptual and need to be further developed to reinforce the implementation strategy.

This TM builds on a prior PWSC planning document, Metropolitan's *Roadmap for Direct Potable Reuse: Considerations for Implementing DPR through the Pure Water Southern California Program* (2024) which provided an overview of the considerations for DPR implementation, regulatory requirements, research needs, benefits, and challenges associated with both RWA and TWA.

To identify the potential PWSC demands, Metropolitan developed a Monte Carlo simulation model that incorporates hydrologic conditions from 2000 to 2024. This model considers each member agency's service connection and DPR (RWA/TWA) applications based on hydrologic factors, supply conditions, and special circumstances, including seismic and emergency events and the implementation of water supply allocation plans. Member agency demands for purified water will be further refined later once the agreements are finalized. The model takes into consideration an evaluation of minimum sustainable flows at the Weymouth Plant, Robert B. Diemer Water Treatment Plant (Diemer plant), and the Joseph Jensen Water Treatment Plant (Jensen plant). The analysis also included evaluation of maximum acceptable flow from new sources, a minimum PWSC online factor of 92%, and water quality considerations, including nitrate and boron compliance strategies. Additional details on demand modeling are discussed in Section 4.

The DPR implementation strategies are aimed at optimizing the overall PWSC structure to enhance local water supply reliability and operational flexibility while reducing the overall cost. Additional technical studies and evaluations are required prior to DPR implementation to ensure regulatory compliance, operational reliability, and long-term system performance. These efforts should include detailed assessments of treatment processes, water quality management (including nitrate, boron, and other constituents of concern), and residuals handling. The potential DPR treatment processes for PWSC will be evaluated at the DPR testing facility (currently in design) to be located at the Grace F. Napolitano Pure Water Southern California Innovation Center (Napolitano Innovation Center) in Carson.

Further evaluation of system integration is also necessary, including hydraulic modeling, blending strategies within the distribution system, and the impact of DPR on existing/planned treatment and conveyance infrastructure. Collectively, these studies will provide the technical approach, risk mitigation, and informed decision-making prior to full-scale DPR implementation.

Section 2: DPR Treatment Considerations

DPR regulations (SBDDW-23-001) were finalized by the State Water Resources Control Board in August 2024 and took effect on October 1, 2024. As shown in **Figure 2-1**, the DPR regulations allow purified water to be used for either (1) RWA incorporation into the raw water influent of a Water Treatment Plant [WTP] or (2) TWA where purified water is introduced directly into a drinking water distribution system.

At this time, the feasibility of DPR is still unknown and will depend on the results of the pilot and demonstration testing scheduled to begin in late 2029. Metropolitan is currently developing both the DPR testing plan and the expansion of the Napolitano Innovation Center facility, where this work will take place. Once completed, the facility will be used over the coming years to evaluate DPR feasibility by testing a range of treatment options.

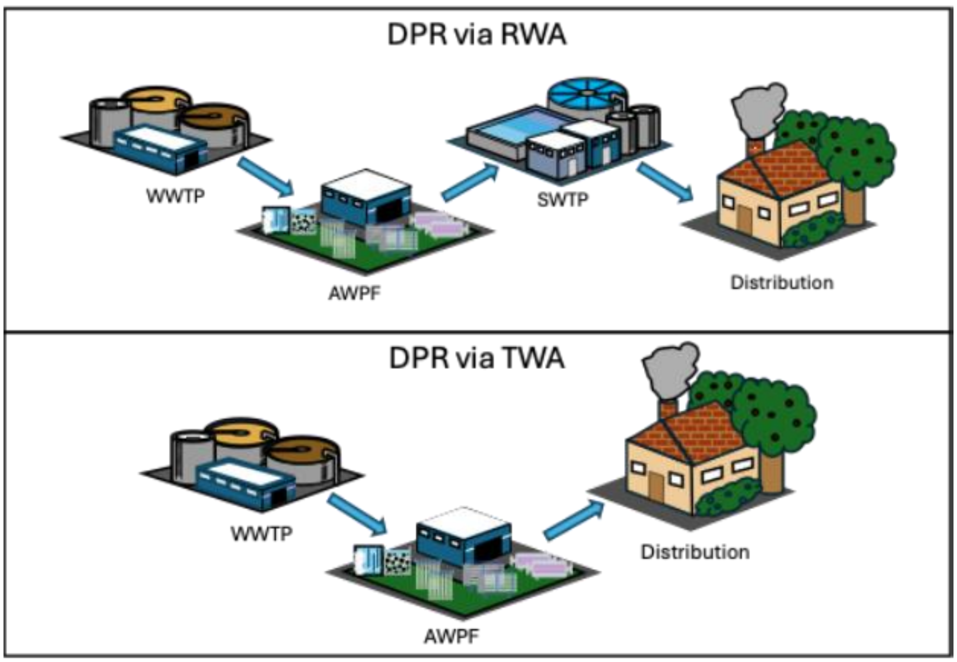
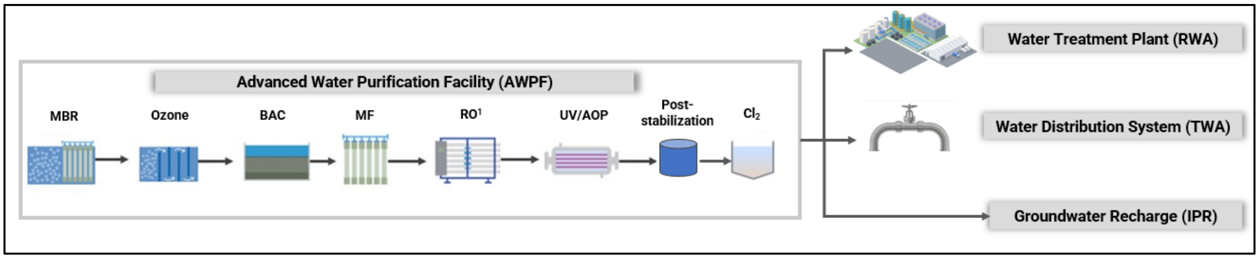


Figure 2-1: Schematic of DPR via RWA (top) and DPR via TWA (bottom)

2.1 DPR Treatment Train

The DPR treatment train (also referred to as the “default” treatment train) prescribed in California’s DPR regulations consists of ozone, biologically activated carbon (BAC), reverse osmosis (RO), and advanced oxidation – in that order – as well as ultraviolet disinfection (UV). PWSC’s complete treatment train would include additional IPR processes in the following order: membrane bioreactor (MBR), ozone, BAC, membrane filtration (MF, for added pathogen log reduction values [LRVs]), two-pass RO (w/o bypass), UV/advanced oxidation process (UV/AOP), post-stabilization, and chloramination, as shown in **Figure 2-2**.



[1]First pass RO: full flow; Second pass RO: full flow

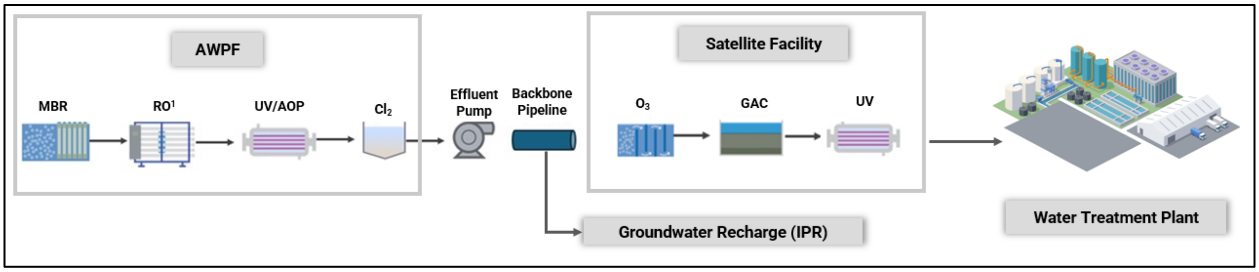
Figure 2-2: Default DPR train for PWSC

California's DPR regulations include an "alternatives clause" that allows deviation from standard treatment trains, such as post-RO DPR treatment barriers, provided that the alternate methods are proven equivalent to the default train. The demonstration of the alternative treatment trains needs to be reviewed by an Independent Scientific Advisory Panel (ISAP) and approved by the Division of Drinking Water (DDW). The selection of any alternative DPR treatment train would depend on the testing results and regulatory approval. Metropolitan will evaluate the efficacy of alternative treatment trains being considered for PWSC at the Napolitano Innovation Center to demonstrate equivalency to the default train and submit for DDW approval.

2.2 Raw Water Augmentation

DPR via RWA is achieved by blending highly purified water with raw water source(s) upstream of a drinking water treatment plant.

For RWA applications in which purified feed water flow is 10% or less of the total water treatment plant flow, DPR regulations do not require ozone/BAC for chemical control. However, when the RWA flow exceeds the 10% blending ratio ozone/BAC is required as a treatment barrier using the default DPR train, or an alternative train is required. This evaluation assumes an ultimate buildout potable reuse capacity of 150 MGD for both IPR and DPR. Under these conditions, the RWA flow is projected to exceed the 10% blending ratio. As a result, alternative treatment train would be required at a satellite facility. As an alternative, using the default DPR treatment train at the AWPF would eliminate the need for additional satellite treatment. However, treating full flows to meet both IPR and RWA demands with the default DPR train at the AWPF may not be cost-effective or feasible, as it would significantly increase the unit cost of purified water. The aforementioned DPR pilot/demonstration facility and DPR testing plan are still being developed by Metropolitan. The testing plan includes the evaluation of alternative treatment options for the RWA application. Figure 2-3 illustrates one potential RWA satellite treatment train for a greater-than-10% DPR blend scenario; additional treatment options will be evaluated.



[1]First pass RO: full flow; Second pass RO: partial/full flow

Figure 2-3: Potential alternative RWA treatment train with satellite facility (greater than 10% DPR blend)

2.3 Treated Water Augmentation

DPR via TWA is a potable reuse strategy in which purified water is introduced directly into the potable drinking water distribution system (e.g. Metropolitan's existing feeders). Although DPR regulations require that RWA and TWA meet drinking water standards, TWA requires more stringent monitoring and a shorter response time due to direct connection to the potable water system. For PWSC, TWA offers clear advantages over RWA for its reduced conveyance requirements, and the potential elimination of a new pipeline to Weymouth. However, TWA applications would require higher treatment reliability, rigorous monitoring, additional complexity to distribution operations, and shorter operations response time to treatment plant upsets or reduced treatment efficacy to ensure protection of public health; all TWA connection options would require an engineered storage buffer to provide appropriate response times

A general process flow diagram of one potential TWA alternative train located in a satellite facility that is being evaluated is shown in **Figure 2-4**. This particular alternative treatment train option is also expected to satisfy treatment requirements when RWA blending is greater than 10%. The testing of alternative treatment trains is required to confirm that the treatment train complies with DPR regulations and can be accepted by DDW.

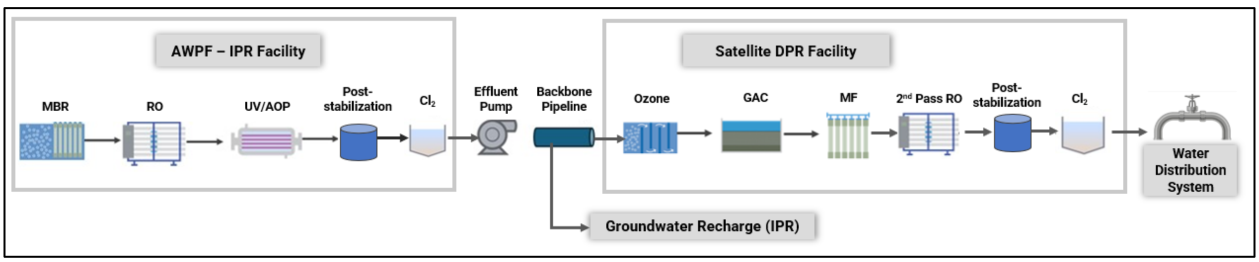


Figure 2-4: Potential alternative treatment train for TWA with satellite facility (greater than 10% DPR blend)

2.4 Water Quality Considerations

The introduction of a new water source, such as purified water from the AWPF, requires a comprehensive understanding of how it could affect water treatment operations and water quality throughout the distribution system. Changes in water quality can directly affect corrosion potential, disinfectant residual decay, disinfection byproduct (DBP) formation, and overall distribution system stability. Therefore, any new water source must undergo a comprehensive evaluation prior to integration into the existing system to ensure regulatory compliance and minimize potential water quality impacts.

2.4.1 Water Quality Non-Degradation Requirement

In February 2001, Metropolitan's Board of Directors considered a pump-in policy to govern the quality of new sources of water introduced into its conveyance facilities. Metropolitan has been using this framework to evaluate the introduction of new water sources while ensuring protection of the quality of water delivered to Metropolitan's service area. The objective of this framework is to protect ambient water quality, allowing new water to be introduced when its quality is equal to or better than existing conditions, while new projects that could diminish downstream water quality require case-by-case stakeholder review, potential mitigation, or consent. This framework also outlines requirements for full characterization of proposed sources, adherence to all primary and secondary drinking water standards, consideration of emerging contaminants, and implementation of comprehensive monitoring programs. The implementation of PWSC may need to be consistent with this framework to ensure protection of water quality. However, as additional treatment and associated costs may be required to meet this non-degradation requirement, further evaluation would be needed.

Nitrate. While advanced treated water (ATW) generally contains lower concentrations of many conventional contaminants, certain constituents may be elevated relative to existing system water quality depending on source wastewater characteristics and treatment configuration. Examples include nitrate, boron, low-molecular-weight biodegradable organics, and wastewater-derived constituents of emerging concern (CECs). As part of the ongoing evaluation, 0.9 mg/L nitrate target level is currently being considered for DPR via TWA, representing the average maximum of the historical nitrate concentrations of Diemer, Jensen, and Weymouth plant effluent. Nitrate target levels used for this evaluation are 4 mg/L as N for IPR, 2 mg/L as N for DPR via RWA, and 0.9 mg/L as N for DPR via TWA.

Boron. Similarly, boron target levels are also being evaluated, with two target levels being considered: (1) 0.5 mg/L, based on the water quality objective for the Main San Gabriel Basin established by the Los Angeles Regional Water Quality Control Board (RWQCB), and (2) 0.57 mg/L, consistent with the analyses in the Environmental Impact Report (EIR) which would require an assimilative capacity evaluation and approval from the RWQCB. A boron concentration of 0.57 mg/L is assumed for this evaluation, providing a consistent basis for assessing treatment requirements and system performance. The nitrate and boron target levels are interrelated because both are removed by RO, and optimizing treatment for one constituent can affect achievable concentrations of the other.

2.4.2 Treatment and Distribution System Limitations

A technical memorandum, *Addendum: Research Needs for Treated Water Augmentation for PWSC,* summarizes the potential benefits and challenges associated with implementing DPR through RWA and TWA, and identifies additional studies needed to further assess these considerations. While both RWA and TWA projects can leverage blending, the extent of blending achievable under a TWA scenario depends on the location where ATW is introduced into the distribution system. If ATW associated with TWA is introduced just downstream of the drinking water treatment plant, the resulting blend would likely be comparable to that in an RWA scenario. However, if the same volume of ATW is introduced towards the end of the distribution system, the resulting blend would likely consist predominantly of ATW.

In addition, TWA implementation entails connecting the ATW pipe directly to the distribution system and, therefore, would require faster/shorter operational response times than RWA projects that convey water over longer distances. Implementing TWA may also result in more localized impacts to water quality compared to RWA. For example, with the introduction of TWA into the treated water pipeline, we have to evaluate how higher blends of advanced treated water in certain areas of the distribution system may affect corrosion. Additionally, purified water is typically warmer than groundwater and surface water supplies. As such, a study should be conducted to evaluate the impacts of purified water on delivered water temperature, as well as the effects of elevated temperatures on disinfectant residual stability and nitrification potential within the distribution system.

Finally, Metropolitan's water treatment plants are constrained by minimum sustainable flow requirements due to limitations in chemical feed systems' turndown capability and insufficient mixing energy at low flows. Provision of greater chemical feed system turndown and improved mixing, however, may not lower the minimum sustainable plant flow due to other water quality issues at flows below that minimum flow. Under low-flow conditions, unstable chloramine formation and accelerated decay in the combined filter effluent channels and finished water reservoirs may compromise the quality of water entering the distribution system, potentially leading to cascading impacts, including further chloramine decay and increased DBP formation. Additionally, Metropolitan's distribution system was originally designed for significantly higher system demands than current operating conditions, when free chlorine was used as the secondary disinfectant and nitrification was not a concern. The lower system demand and the resulting extended water detention time, combined with the use of chloramine as the secondary disinfectant, have led to increased occurrence of nitrification. The integration of PWSC into Metropolitan's system should take into consideration these existing constraints to minimize potential operational and water quality impacts on the existing system.

Section 3: Existing Infrastructure for DPR Use

To implement DPR, an assessment of Metropolitan's existing infrastructure is needed to identify suitable connection points considering potential demands, engineered buffer options, and other for operational considerations. This section identifies and evaluates the potential DPR connection locations and engineered buffer locations within Metropolitan's potable water system. Preferred connections were utilized in the operations model to assess potential TWA demands within the system, as discussed in the next section.

Discussions were held with Metropolitan staff to identify potential RWA and TWA connection locations and engineered buffers (as discussed below), review potential implementation challenges at each location, and gain insights into how the new connections and engineered buffers may operate. These potential connection points and engineered buffers were assessed for their capacity and infrastructure requirements. Figure 3-1 shows a map of potential connections and engineered buffers for DPR applications.

The potential DPR connection points and engineered buffers considered in this evaluation were selected based on available water demands (for feeders), storage capacity (for engineered buffers), and proximity to the AWPF, potential satellite plant sites, the backbone pipeline, and IPR service connections.

The Upper Feeder was excluded from consideration as a connection point due to its remote northern location, which lies beyond the connection points and pipelines associated with the Weymouth Plant.

Figure 3-1: Map of Potential DPR Connection Locations and Engineered Buffers

3.1 Potential RWA Connection

The Weymouth Raw Water Junction Structure provides tremendous operational flexibility for RWA implementation, allowing deliveries of purified water to both the Weymouth plant as well as the Diemer plant via Metropolitan's Yorba Linda Feeder.

3.2 Potential TWA Connection – Feeders

This section evaluates Metropolitan's existing treated water feeders to identify key considerations and recommendations based on hydraulic evaluations. Historical flow and hydraulic grade data at the potential connection points were provided by Metropolitan. These data served as the foundation for understanding the range of flows within Metropolitan's existing feeders to receive purified water.

It is important to note that Metropolitan has experienced significant nitrification events in recent years due to ongoing decreases in treated water demands. This has led to increased water age and more frequent nitrification events. The addition of TWA into Metropolitan's system will only further increase water age and lead to more nitrification events. In addition, the true cost of DPR must include additional capital and/or O&M costs to address more frequent nitrification events in Metropolitan's system. However, to estimate this cost at this time would be challenging due to many unknown factors.

The raw data were reviewed for anomalies, such as long periods of zero/near-zero flow, or grade variability caused by shutdowns, and then were verified with Metropolitan. The revised flow and grade data were then used to calculate relevant metrics, such as maximum and minimum flow and grade, 5th and 95th percentile flow and grade, monthly and yearly averages for flow and grade. For bidirectional feeders, additional calculations were performed to determine the percentage of time flowing in different directions and the percentage of time with no flow. These metrics were used to understand overall flow and pressure trends at each feeder connection location.

Feedback and insights from Metropolitan staff were also considered when evaluating potential connection locations, including potential water quality concerns and the daily variability in the direction of flow in bi-directional feeders depending on the operational mode. Additionally, flows from upper zone feeders can flow into smaller, lower zone feeders, and it is difficult to predict how much water transfer occurs. Metropolitan staff indicated it is reasonable to assume that flows through the SLF, LF, and MF are independent of each other. However, the LF and PVF are not independent because the LF provides treated water to the PVF.

The UF was not evaluated since it is further north of the future DPR pipeline tie-in location from the backbone pipeline to the Weymouth plant, resulting in limited cost savings. Feeding ATW into the existing feeders would require a pressure regulator and flowmeter to control ATW pressure to match the existing feeder pressure. The following three configurations for TWA connection were evaluated in this TM:

1. Feeder connections near the AWPF would receive full DPR treatment at the AWPF, allowing shorter pipeline runs and reduce downstream backbone pipeline sizing.
2. Feeder connections that would utilize a satellite facility for additional DPR treatment would require a connection from the backbone pipeline to the satellite treatment facility as well as a tie-in from the satellite facility to the feeder connection point. These options would reduce downstream backbone pipeline sizing. The required satellite treatment facility infrastructure, including available sewer capacity for MF system backwash and CIP waste discharges, would need to be evaluated.

3. Feeder connections that would utilize a dedicated delivery pipeline require a separate pump station at the AWPF to convey water to the corresponding feeder connection point. These scenarios would reduce downstream backbone pipeline sizing.

Feeders evaluated for potential TWA connections include the following:

- Palos Verdes Feeder (PVF) at Sepulveda Boulevard
- Second Lower Feeder (SLF) at Main Street
- SLF at Carson Street (at the Victoria Cross Feeder)
- Lower Feeder (LF) at Downey Norwalk Road
- Middle Feeder (MF) at Ramona Boulevard

3.2.1 Palos Verdes Feeder

A TWA connection to Metropolitan's existing PVF, near Station 1496+00, was evaluated. The PVF operates in a single direction and flows south. There are 11 existing service connections between the potential feeder tie-in location and the downstream PVR, and the closest service connection is located 528 feet south of the tie-in from the AWPF, which likely would not allow for full mixing to occur before delivery to end users. As a result, it is possible that some service connections near TWA tie-in locations may receive 100 percent DPR-quality water. Advantages of tying into the PVF include the short distance from the AWPF and a lower hydraulic grade, which requires less pumping capacity to match the existing conditions. Similar to the PVR, a disadvantage of this option is that the PVF delivers water to only a relatively small service area, offering less opportunity for TWA. Connecting to the PVF provides limited additional benefit relative to feeding into the LF because the LF and PVF are not always independent; the LF also supplies water to the PVF. Based on these challenges, the PVF was determined to be an unfavorable option for a TWA connection.

3.2.2 Second Lower Feeder

The SLF has 29 miles of prestressed concrete cylinder pipes (PCCP) and varies in diameter from 84 to 78 inches. As part of Metropolitan's PCCP Rehabilitation Program, the SLF PCCP pipelines were identified as at-risk pipelines prioritized for rehabilitation. Metropolitan has been systematically rehabilitating the existing PCCP by installing steel liners with cement mortar lining. SLF connections at Main Street and at the Victoria Cross Feeder (VXF) were evaluated. Once completed, the SLF would be able to deliver an additional 30 cfs of flow.

3.2.2.1 Second Lower Feeder (at Main Street)

A TWA connection to Metropolitan's existing SLF near Main Street at Station 1764+00, was evaluated. The SLF operates bi-directionally, with flow traveling west and east 69% and 31% of the time, respectively. The nearest service connection is located 2.7 miles west of a potential TWA connection along the backbone pipeline. An advantage of tying into the SLF at Main Street is that there are no nearby service connections; this allows for adequate mixing to occur before water is delivered to end users. Disadvantages include a higher hydraulic grade, which requires a larger pumping capacity and offers less operational flexibility compared to the tie-in location near the VXF, discussed below. Additionally, a connection further east along the SLF would provide more potential demand opportunities for TWA. Therefore, a tie-in at Main Street was considered to be less favorable than the SLF connection at the VXF.

3.2.2.2 Second Lower Feeder (at the Victoria Cross Feeder)

A TWA connection to the SLF, both upstream and downstream of the VXF interconnection, near Station 1594+17, was evaluated. The nearest service connections are located 3.3 miles east along the SLF and 0.1 miles south along the VXF. This option would allow flexibility to deliver water to the SLF and VXF. One disadvantage of this connection location is its higher hydraulic grade, which would require a larger pumping capacity. A blending evaluation would be required to determine the ultimate purified water contribution at the nearest service connection (0.1 miles). The interconnection of SLF and VXF provides the capability of distributing the advanced treated water across multiple service areas, which could result in more demand opportunities. This location benefits from its proximity to the proposed backbone pipeline and would require only a short length of additional piping. Furthermore, this location benefits from an adjacent large undeveloped work yard that may accommodate construction staging and operational needs if the area has not yet been planned for future development.

3.2.3 Lower Feeder

The LF was constructed in the 1960s to convey treated water from the Diemer plant in Yorba Linda to the Rio Hondo Pressure Control Structure (PCS) in the city of South Gate, where the water is supplied to the central pool via the West Coast Feeder, Middle Cross Feeder, and MF. The LF runs 21 miles and varies in diameter from 96 to 78 inches. A TWA connection to the LF at approximately Station 2218+40 was evaluated. The LF operates bidirectionally, with flow traveling west and east 87% and 13% of the time, respectively. The nearest service connections are located 0.8 miles west and one mile east. Because of the interconnections within the Central Pool system, many of the LF demands can be met by connecting to the SLF, which is at a closer distance from the AWPF. Given its similarities to SLF, LF was not further analyzed.

3.2.4 Middle Feeder

The MF is a pipeline within Metropolitan's distribution system that plays a role in stabilizing flow rates and maintaining water deliveries to member agencies, especially during maintenance shutdowns. The 72-inch-diameter feeder conveys water 21 miles from the Weymouth plant in La Verne to the Garvey Reservoir in Monterey Park, allowing for hydraulic flexibility by stabilizing flow rates within the feeder.

A TWA connection to the MF (near Station 691+28), either downstream or upstream of the Ramona PCS, was evaluated. The MF operates unidirectionally, with flow traveling west. The nearest service connection is located two miles west of this MF connection point. The maximum hydraulic grade is 617 feet downstream of the Ramona PCS and 795 feet upstream of the Ramona PCS. Water age issues between the Weymouth plant and Garvey Reservoir need to be further evaluated as part of the TWA technical studies. A TWA connection at MF provides the advantage of using the storage capacity in Garvey Reservoir for addressing operational response time and allowing service to downstream demands.

3.2.5 Feeder Evaluation Summary

The SLF provides significant capacity and TWA demands; and is the nearest connection point to the AWPF. Its bi-directional flow configuration provides operational flexibility, though the resulting variable flow and pressure fluctuations present challenges for integrating TWA deliveries.

The MF, supplemented by an engineered buffer at Garvey Reservoir, also provides an option for the purified water TWA connection and offers enhanced water quality management and improved operational response times through the availability of reservoir storage.

Connecting to the feeders will require overcoming the existing feeder line pressures. This will be achieved by over-pumping and using automated pressure regulators that can measure pressure within both the SLF and MF. Further evaluation of the operation, maintenance, and space required for these pressure-regulating facilities should be considered for these options. Findings from the hydraulic evaluation for each of the potential feeder connections are summarized in **Table 3-1** and discussed in the subsections that follow. It should be noted that advanced hydraulic analyses, such as surge analysis, and detailed operational analyses, such as reviewing how the booster pumps and treatment plant flows would work in tandem, have not been undertaken as part of this high-level evaluation.

Table 3-1: Evaluation Summary of Potential TWA Feeder Connections

Feeder Tie-In	Palos Verdes Feeder	Location of Second Lower Feeder (SLF)		Lower Feeder	Middle Feeder[1]
		Main Street	Victoria Cross Feeder (VXF)		
Direction	Unidirectional (south)	Bidirectional (west-east)	Bidirectional (west-east)	Bidirectional (west-east)	Unidirectional (west)
Percentage of Flow Direction	100% S	69% W, 31% E	69% W, 31% E	87% W, 13% E	100% W
Nearest Service Connections	WB-5 & LA-5 (0.1 mi S)	T-08 (2.7 mi W)	WB-37 (0.1 mi S) CENB-19 (3.3 mi E)	CENB-15 (1.0 mi W) CENB-27 & CENB-28 (0.8 mi E)	CENB-32 (2.0 mi W)
Distance from Backbone	1.3 mi	1.4 mi	0.1 mi	0.1 mi	0.1 mi
Grade and Flow					
Feeder Maximum Hydraulic Grade (feet)	390	660	660	660	617 U/S 795 D/S
Notes					
Shortlisted/ Eliminated	Eliminated	Eliminated	Shortlisted	Similar to SLF and not further analyzed	Shortlisted
Rationale	Does not provide significant demand to help meet the maximum potential DPR demands and is likely redundant with the SLF connection.	Does not provide maximum potential DPR demand and provides less operational flexibility than a connection closer to the VXF	Provides maximum DPR demands and operational flexibility to direct flow to the VXF (if connections are installed west and east of the VXF)	Demands can be met with SLF.	Provides maximum potential DPR demands. Strategies for mitigating water age need to be developed

Notes:
[1] The maximum feeder grade is provided for both upstream and downstream of the Ramona Pressure Control Structure.
D/S = downstream
U/S =upstream

3.3 Engineered Storage Buffers

An engineered storage buffer (ESB) is recommended downstream of the advanced water purification facility (AWPF) at TWA connection points to provide additional response time beyond that available from the facility Clearwell and to enhance overall operational reliability. While existing storage may satisfy minimum regulatory response time requirements, additional ESB volume increases the available response time (T10), providing operators with valuable time to verify monitoring data, confirm treatment or instrumentation failures, troubleshoot process upsets, and implement corrective actions before a diversion event is required. The additional storage also provides greater flexibility for managing plant operations during abnormal conditions and reduces the potential for unnecessary diversions resulting from transient processes or monitoring anomalies.

Beyond regulatory considerations, an ESB provides important hydraulic benefits for integration of purified water into the regionally treated water system. Because storage volume within the treatment process is limited, the ESB serves as a balancing reservoir that accommodates operational fluctuations, flow transitions, and temporary interruptions in production or delivery. The storage volume also helps attenuate hydraulic transients and surge pressures associated with rapid changes in pumping rates, valve operations, or diversion events. By buffering these system dynamics, the ESB helps protect the purified water backbone pipeline as well as existing Metropolitan feeder pipelines from potentially damaging pressure fluctuations, while improving system resiliency and providing greater operational flexibility for both routine and emergency operating conditions. All TWA connections should include an ESB, apart from existing reservoir options, which themselves would serve as an ESB.

3.4 Potential TWA Connection – Reservoirs

The Weymouth FWR has been identified as a potential TWA connection point. A direct TWA connection to the Weymouth plant's FWR could be advantageous, as it would offer Metropolitan the ability to meet additional demands in Metropolitan's Central Pool via the MF, or through other connected feeders, and to supplement Weymouth plant production to meet demands even when the Weymouth plant is out of service. However, given its current operational configuration and with reservoir water surface elevation governed by distribution system hydraulics, the usable storage volume is constrained and is expected to provide only limited buffering capacity. A detailed review of the flows and operations of the FWR would be required. Incorporation of TWA at the FWR would require the construction of approximately 12 miles of new pipeline to convey up to 60 MGD of purified water from the backbone pipeline to the Weymouth plant. TWA implementation at the Weymouth FWR could be accomplished through further treatment at a satellite facility located at the Weymouth plant site.

3.5 Evaluation of Options for Engineered Buffer

Historical data of reservoir levels, inflows, and outflows were analyzed for the hydraulic feasibility of Metropolitan's existing FWRs to be considered for DPR integration as an engineered buffer. Raw hydraulic data were analyzed along with input from Metropolitan staff. The data on levels and flows were then used to calculate relevant metrics, such as spillway crest and maximum water surface elevation (WSE), maximum and available storage capacities, and average inflow and outflow. These metrics were used to understand available storage and outlet pipeline demand trends at each potential connection.

Engineering buffers evaluated include the following:

- Palos Verdes Reservoir (PVR)
- Garvey Reservoir (Garvey)
- Weymouth Finished Water Reservoir (FWR)

3.5.1 Palos Verdes Reservoir

The Palos Verdes Reservoir (PVR) is a finished water reservoir located approximately 4.3 miles southwest of the AWPF site. It is confirmed to be out of service for the foreseeable future and could be repurposed for TWA use. The reservoir serves three Metropolitan service connections to the south along the PVR Second Outlet Pipeline. The current spill crest elevation is 312 feet, reduced from its previous height of 324.5 feet. Available operational data from 2019 to 2024 showed an average WSE of 280 feet and a maximum WSE of 312 feet, indicating the reservoir reached full capacity on the maximum recorded day Table 3-2. Per discussion with Metropolitan staff, the reservoir was filled to its maximum level for specific maintenance activities, not typical operational conditions. Utilizing the full storage potential with a spill crest elevation of 310 feet would yield 695 acre-feet (AF) of storage, however further operational assessments are needed to determine the storage available for TWA without impacting water quality or other operations. PVR could be considered as a limited demand option for TWA and could be further evaluated to serve as an engineered buffer for the SLF option.

3.5.2 Garvey Reservoir

The Garvey Reservoir (Garvey) is a finished water reservoir located approximately 6.4 miles west of the intersection of the MF and backbone pipeline, which was identified as a potential TWA delivery location. Garvey serves nine service connections along the MF South before intersecting with the Lower Feeder (LF). Garvey has a 10-year maximum WSE of 562 feet, providing 1,610 AF of maximum storage capacity and 373 AF of available storage capacity. However, further operational assessments are needed to determine the storage available for TWA without impacting water quality or other operations. Currently, Garvey has been out of service since March 2025 due to integrity issues with its floating cover. Garvey improvement projects are currently under construction.

Once operational assessments are conducted, Garvey could provide storage benefits for TWA flows introduced in the MF and satisfy Metropolitan's downstream central pool demands. Garvey also provides an opportunity for TWA blending and as an engineered storage buffer. However, detailed studies may be required to address potential challenges associated with exacerbating water age concerns within the Garvey Reservoir and along the MF.

3.5.3 Weymouth Finished Water Reservoir

Weymouth Finished Reservoir could serve as a TWA engineered buffer to serve the demands in the MF, as discussed in Section 3.3.

3.5.4 Evaluation Summary – Engineered Buffer Options

The evaluation of the potential engineered buffer locations is summarized in Table 3-2. PVR has been identified as a candidate for future connections to support the drought projects. Garvey Reservoir has been shortlisted for use as an engineered buffer in conjunction with the MF TWA option, and the Weymouth FWR has been similarly shortlisted for use as an engineered buffer for the Weymouth TWA option. Details of these DPR operations scenarios are provided in Section 5.

Table 3-2: Potential Engineered Buffer Summary

Engineered Buffer	Palos Verdes	Garvey	Weymouth FWR
Service	Treated Water	Treated Water	Treated Water
Approx. Distance from Backbone (mi)	4.3	6.4	12
Storage			
Maximum Capacity (AF)	695	1,610	151
Notes			
Shortlisted/ Eliminated	Shortlisted for future connections upon completion of the drought projects	Shortlisted for TWA	Shortlisted for TWA
Rationale	Could be considered as a limited demand option for TWA	Could accept MF TWA flows to serve downstream demands and provide storage benefits. Operational issues could exist, including water age.	Could accept Weymouth TWA flows and provide operational benefits.

Section 4: Demand Projections

4.1 Overview of the Model

To properly project the overall and different types of PWSC demands, Metropolitan developed an operational model that considers each member agency's service connection and the DPR (RWA/TWA) applications based on hydrologic factors, supply conditions, and special circumstances, including seismic events and the implementation of water supply allocation plans. The model is a Monte Carlo simulation and encompasses hydrologic conditions from 2000 to 2024 with a daily time step, resulting in more than 9,000 individual data points. A Monte Carlo simulation uses actual data to assess uncertainty and estimate the probability of different outcomes.

4.2 Input/Outputs to Model

Member agency demands for PWSC were developed based upon draft term sheets (Figure 4-1) and included in the model. These potential IPR demands would be from the Los Angeles Department of Water and Power (LADWP), West Basin Municipal Water District (West Basin), Long Beach Utilities (Long Beach), Central Basin Municipal Water District (Central Basin), Upper San Gabriel Valley Municipal Water District (Upper Water), Three Valleys Municipal Water District (Three Valleys), and San Gabriel Valley Municipal Water District (SGVMWD). Figure 4-1 shows the ranges in IPR and the median value for each member agency based upon the model.

Actual data from 2000 to 2024 for the SLF, LF, MF, and Weymouth and Diemer plants were also input into the model to address boundary conditions for RWA and TWA. The operational model was used to evaluate the DPR implementation scenarios in this TM.

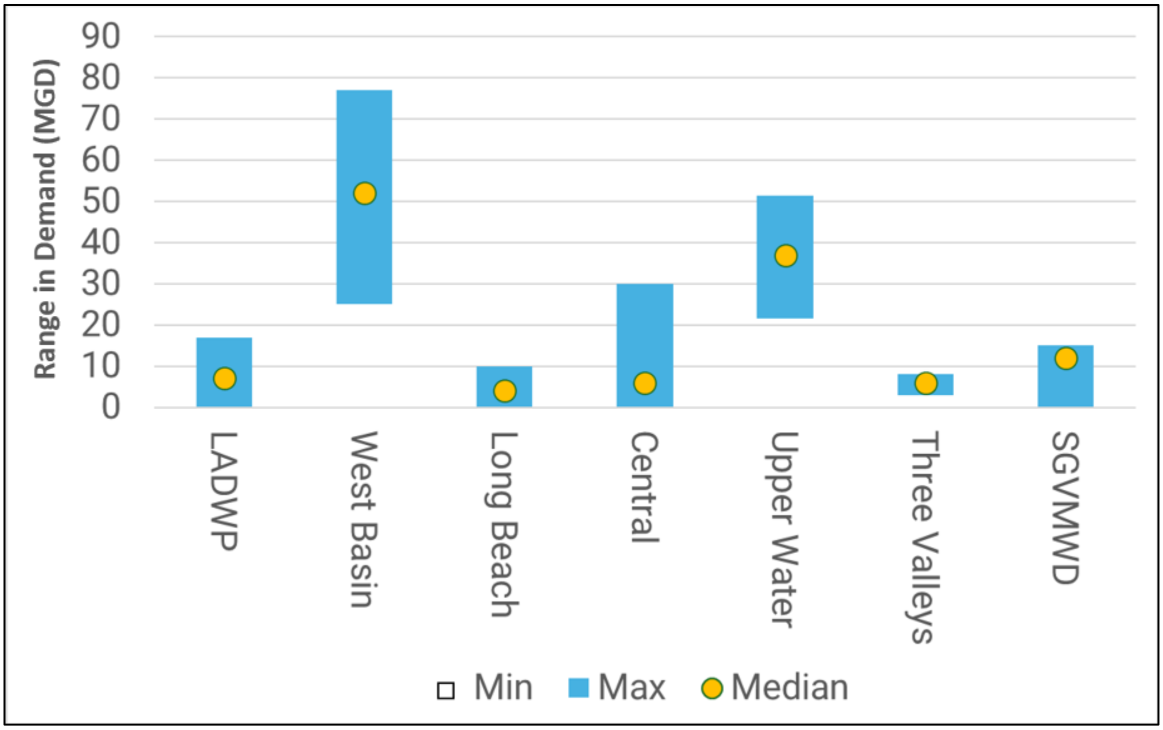


Figure 4-1: Potential PWSC Demand Ranges for Member Agencies

4.2.1 Minimum Online Factor

A minimum online factor of 92 percent is used in the model for consistency with the previous EIR analyses and financial assessments provided to the Metropolitan Board. The 92 percent online factor was established originally for an IPR-only program, representing approximately 30 days of downtime per year in the spreading grounds, injection wells, and other member agency demands. The draft member agency term sheets include an expected annual average purchase based upon this 92 percent online factor. In the model runs, if the calculated online factor was less than 92 percent, the DPR capacity would be increased until the 92 percent online factor was achieved.

4.2.2 Minimum Sustainable Flow for Water Treatment Plants

The model includes an evaluation of minimum sustainable flows (MWD, 2011) at the Weymouth, Diemer, and Jensen plants, which are discussed in Section 2.4.2 and summarized in **Table 4-1**.

Table 4-1: Summary of Minimum Sustainable Flow

Water Treatment Plant	Minimum Sustainable Flow (MGD)
Weymouth	60
Diemer	70
Jensen	60

MGD = million gallons per day

4.2.3 Demand Variations by Hydrologic Conditions

This section characterizes the hydrologic variability in demands and evaluates the following hydrologic scenarios:

- Wet Years

- Normal Years
- Dry Years
- Extreme Dry Years

For this study, the hydrologic variability assumptions are similar to 'Scenario C' evaluated in the Integrated Resources Plan (IRP) and the CAMP4Water assessments. Under 'Scenario C', demands are assumed to be low while imported water supplies are reduced. As imported supplies availability declines, the likelihood of shortages increases despite lower and flat demands, underscoring the need for additional supplies from PWSC.

Figure 4-2 shows the probability of exceedance forecast in 2045 for State Water Project (SWP) Table A percentage under 'Scenario C'. This figure shows a range of projected SWP allocations from approximately 3 percent to 95 percent of the SWP Table A allocation. Based upon this figure, it is assumed that wet and normal conditions will occur about 56 percent of the time, while dry and extreme dry conditions occur about 44 percent of the time. Under 'Scenario C', a shortage is estimated to occur about 18 percent of the time. The demand variations described below would apply to IPR, RWA, and/or TWA. Factors that define whether a year is a wet, normal, dry, or extreme dry year include local rainfall, SWP Table A allocation, or whether there are unmanaged flows or a net shortage.

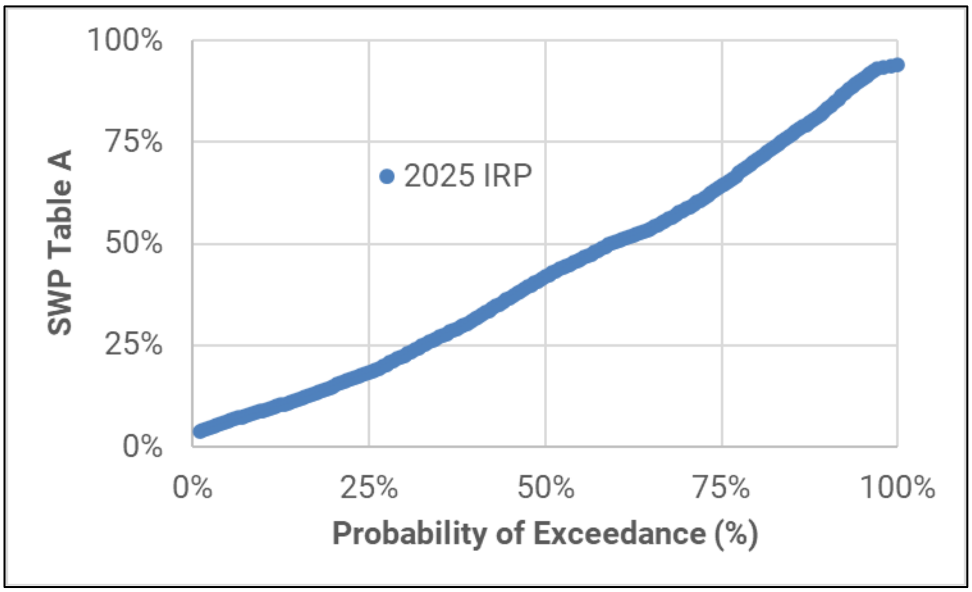


Figure 4-2: Exceedance Forecast for SWP Table % in 2045 (Scenario C)

Each section below describes how hydrology would impact the purified water demands. For RWA and TWA, the full range of actual data for each hydrologic condition during the evaluation period is used, unless otherwise specified. Additional conditions evaluated include groundwater recharge basin availability, downtime, and emergencies such as earthquakes.

Wet Years'

Wet years refer to years when the precipitation in the Metropolitan service area is greater than 120 percent of normal and the SWP Table A allocation is at least 75 percent, or if there are unmanaged supplies on the SWP. Wet years are expected to occur about 16 percent of the time under 'Scenario C'. During a wet year, and when Metropolitan's demand balance is in surplus, SWP water may need to be prioritized to avoid unmanaged SWP supplies. To avoid unmanaged supplies, member agencies within SWP-dependent areas and groundwater replenishment entities would take less purified water from PWSC for groundwater replenishment and instead draw water from their existing imported water connections. These agencies include Upper Water, Three Valleys, Central Basin, and Long Beach.

Normal Years

Normal years are non-wet years with an SWP Table A allocation of at least 35 percent. During these years, IPR demands would be maximized as much as possible. No deliveries are expected to Central Basin during normal years.

Dry Years

During dry years, when the SWP Table A allocation is between 10 and 35 percent, deliveries from PWSC would be similar to those in normal years. It is expected that Central Basin deliveries of 30 MGD will be made only during dry years.

Extreme Dry Years

Extreme dry years are defined as those with an SWP allocation of less than 10 percent, or if there is an unmet supply need. Shortage is expected to occur about 18 percent of the time under ‘Scenario C’. During these years, DPR (either RWA or TWA) would be prioritized to maximize deliveries to the system. Deliveries to Upper Water, Three Valleys, Central Basin, and Long Beach would be minimized. In addition, West Basin deliveries for groundwater replenishment (excluding seawater intrusion barrier deliveries) would also be minimized. It was also assumed that during extreme dry years, a mandatory Water Supply Allocation (WSA) Level 2 would be in place. This would require a mandatory 10 percent regional reduction in demand which impacts both IPR and DPR demand projections.

Other Monthly Variations Based on Hydrology

For this analysis, it is assumed that PWSC will handle West Basin’s demand variability for program capacity above 75 MGD, including minimum-day and peaking demands up to 77 MGD, with an average-day demand of 52 MGD. To create a demand profile based upon hydrology, the following assumptions were used:

- Wet years: Average of 2019 and 2023
- Normal years: Average 2019 through 2024
- Dry years: Average 2020 through 2022
- Extreme dry years: Average 2022

Note that, for some of the scenarios, the maximum IPR deliveries may be limited to 75 MGD. Under these scenarios, the average daily demand for West Basin would be limited to 40 MGD.

Figure 4-3 shows the monthly demands for West Basin for the four hydrology scenarios. Note that the dry year and extreme dry year scenarios are not significantly different.

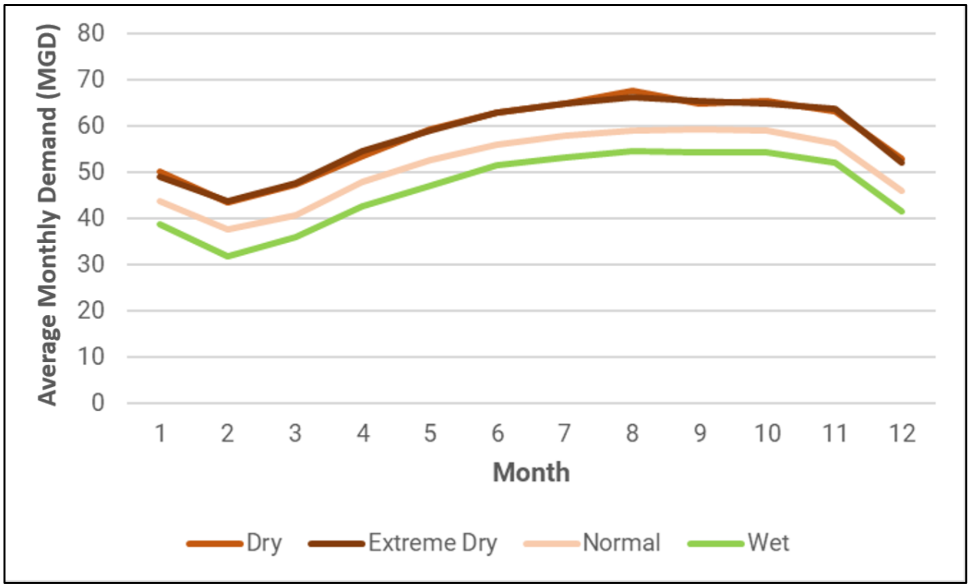


Figure 4-3: Monthly West Basin Deliveries by Hydrology

4.2.4 Demand Variations due to Recharge Availability (Spreading Grounds, Injection Wells)

Metropolitan would purchase a gravel pit or other property that would be dedicated to PWSC and enter into an agreement with the Los Angeles County Department of Public Works to operate it. Los Angeles County Department of Public Works requires that all maintenance on spreading grounds in their system, including the Santa Fe Spreading Grounds (SFSG), San Gabriel Canyon Spreading Grounds (Canyon or CYN), San Gabriel Coastal Spreading Grounds (Coastal), and the Rio Hondo Spreading Grounds (Rio Hondo), and Metropolitan's potential dedicated recharge area must be completed by October 15 each year. The maintenance for Metropolitan's dedicated facility is expected to take approximately 2 weeks in September.

For the model, 2-week periods were randomly selected, with the first occurring between September 1 and September 15 each year. It is not expected that all spreading grounds would be down for maintenance at the same time; therefore, this randomization process helps to maximize deliveries and is more consistent with current operations. Spreading grounds may be partially open for deliveries during the maintenance periods.

Injection wells are expected to meet recharge needs for West Basin and for Long Beach. Similar to the spreading grounds, injection wells are expected to be down for annual maintenance in September as well. The period of maintenance for injection wells is also 2 weeks. A similar randomization process with injection well maintenance beginning between September 1 and September 15 was applied for injection wells.

4.2.5 Demand Variations due to Downtime/Emergency

Downtime for an emergency condition for all service connections and facilities (both IPR and DPR) is estimated to be 1 percent of the time, on a random basis. The downtime period was assumed to be 7 days. The probability that all facilities would be down for an emergency at the same time was <0.1% in the model.

The model also includes downtime for the City of Los Angeles's Terminal Island Treatment Plant (Terminal Island), which serves LADWP's Harbor Loop system. It is assumed that LADWP may roll onto the PWSC system during an emergency event in the Harbor Loop system with an additional demand of approximately 10 MGD. It is expected that this event may occur up to 1 percent of the time, with a downtime period of 7 days.

A strong earthquake (e.g., M 7.8 ShakeOut Scenario) on the southern San Andreas Fault system, the CRA, the SWP, and the Los Angeles Aqueduct (LAA), which cross the San Andreas Fault, could be severely damaged. The extent of damage from this type of event could potentially cause protracted outages of the facilities, halting the flow of imported water. These outages could range from several months to extended periods of time on one or more of the aqueducts.

PWSC is located on the coastal side of the San Andreas Fault, with the nearest facilities more than 20 miles away from the fault, which could make the water produced from PWSC available during an earthquake emergency and significantly improve the seismic resilience of the region. Purified water would be available to maintain water flow in the Weymouth and Diemer plants (or via a treated water pipeline) even if imported supplies were cut off by the earthquake event. This would enable Metropolitan to continue meeting the demands of member agencies throughout the emergency.

Under the catastrophic loss of water supply, the following actions will be implemented, which serve as the criteria for determining Metropolitan's Emergency Storage:

- Suspend any existing interruptible water deliveries, such as replenishment deliveries.
- Restrict firm supplies by a mandatory cutback of 25 percent (WSA Level 5) from normal-year retail demand levels, which would affect demands for IPR and DPR.
- Full local groundwater production, recycled water, and local surface emergency storage reserve production would be sustained (PWSC would remain fully operational); and
- Metropolitan would draw on its emergency storage as well as other available storage.

Based upon a study of emergency storage prepared in 2019 (Board Letter Item 9-3, May 14, 2019), the outage due to a seismic event on any one of Metropolitan's source supplies would range from a few months to as long as five years as shown below:

- Colorado River Aqueduct: 2 to 6 months (recovery of 80% CRA capacity) or 3 to 5 years (recovery of 100% CRA capacity)
- California Aqueduct East Branch 12 to 24 months
- California Aqueduct: West Branch 6 to 12 months
- Los Angeles Aqueduct: 18 months

Adequate local supply available during a seismic outage was estimated in this study to range from 1 to 1.2 MAF. Since recycled water projects such as PWSC are assumed to be 100 percent available during a seismic outage, PWSC could increase local supplies by up to 15 percent during a seismic emergency. Increasing the effective local supply available during the emergency could reduce pressure on Metropolitan's emergency storage reserves (Metropolitan, 2023).

Purified water from PWSC would be available to keep water flowing as replenishment water to the groundwater basins to maintain production throughout the emergency. Using additional local groundwater and RWA/TWA during an emergency would allow Metropolitan to move what imported water is available to the areas where it is needed most. For this study, it is assumed that during an earthquake, DPR deliveries would have priority, and all groundwater replenishment deliveries would be minimized to keep as much water in the Metropolitan Water system. NPR/IPR deliveries would be reduced to as low as 50 MGD during these periods.

There is a 31 percent chance of a magnitude 7.5 or greater earthquake in the Los Angeles region within 30 years, or a 1 percent per year probability. The chance of a 7.5+ earthquake during the modeling period was approximately 25 percent. During a major earthquake event, RWA or TWA would be prioritized. Deliveries for groundwater replenishment (excluding deliveries for seawater intrusion barriers) would be minimized.

4.2.6 Blending to Achieve Water Quality Targets

As discussed in Section 2.4.1, Metropolitan established a framework that allows the introduction of new water if its quality is equal to or better than the ambient quality of water in the conveyance facility. Ambient quality is defined as the representative concentration for any constituent at the beginning of the conveyance facility.

For constituents that exceed ambient water quality standards, the policy provides case-by-case consideration subject to approval by potentially impacted downstream stakeholders. Approval may be granted if the introduced water does not produce significant impacts to downstream stakeholders, if any adverse impacts are fully mitigated, or if each downstream stakeholder agrees to the proposed operation. The model targets nitrate and boron concentrations of 4 mg/L (as N) and 0.57 mg/L, respectively, for IPR; 2 mg/L nitrate for RWA; and two nitrate targets of 2 mg/L and 0.9 mg/L for TWA. If the water quality targets cannot be achieved through blending, additional treatment would be required to comply with the policy.

4.2.7 Maximum Acceptable Flow from New Sources

The model included an evaluation of maximum acceptable flow from new sources.

Indirect Potable Reuse

To help determine how much RWA or TWA can be achieved, it is important to evaluate the range of possible IPR deliveries based upon the assumptions provided above. Figure 4-5 shows the probability of exceedance (i.e. probability that the IPR demand will be higher than the data shown) for the range of IPR demands. As shown in Figure 4-4, the IPR demands range from 50 to 150 MGD. Demands less than 75 MGD represent earthquake or other emergency events, extreme dry year condition, or downtime for the spreading basins. As shown in this figure, about 70 percent of the time, the IPR demands range from 75 MGD to 120 MGD, the most likely range for scenario development going forward.

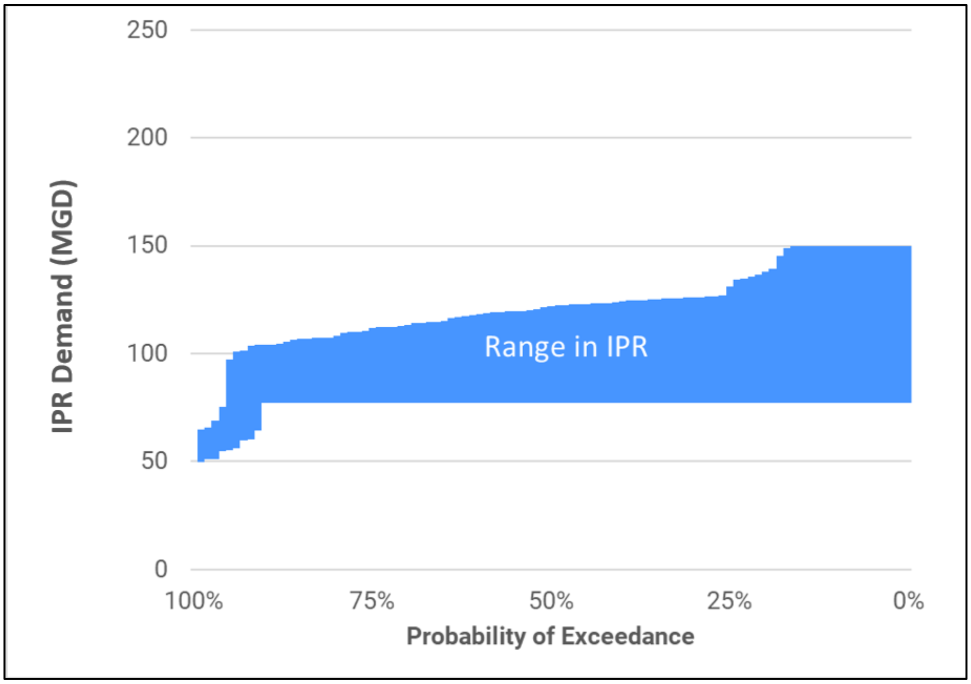


Figure 4-4: Probability of Exceedance for IPR

Raw Water Augmentation

Figure 4-5 shows the probability of exceedance (i.e. probability that the RWA demand will be higher than the data shown) for the range of these demands. As shown in Figure 4-5, the range of RWA demand is from 0 to 60 MGD as shown in the green bar. As IPR demands increase to as high as 150 MGD, the RWA projected delivery may be 0 to 20 percent of the time. The green dotted line show the historical range of demand for Weymouth and Diemer WTPs. The orange line shows the capacity of the Weymouth and Diemer WTPs. As shown in this figure, the amount of raw water augmentation is small compared to the total flow at Weymouth and Diemer.

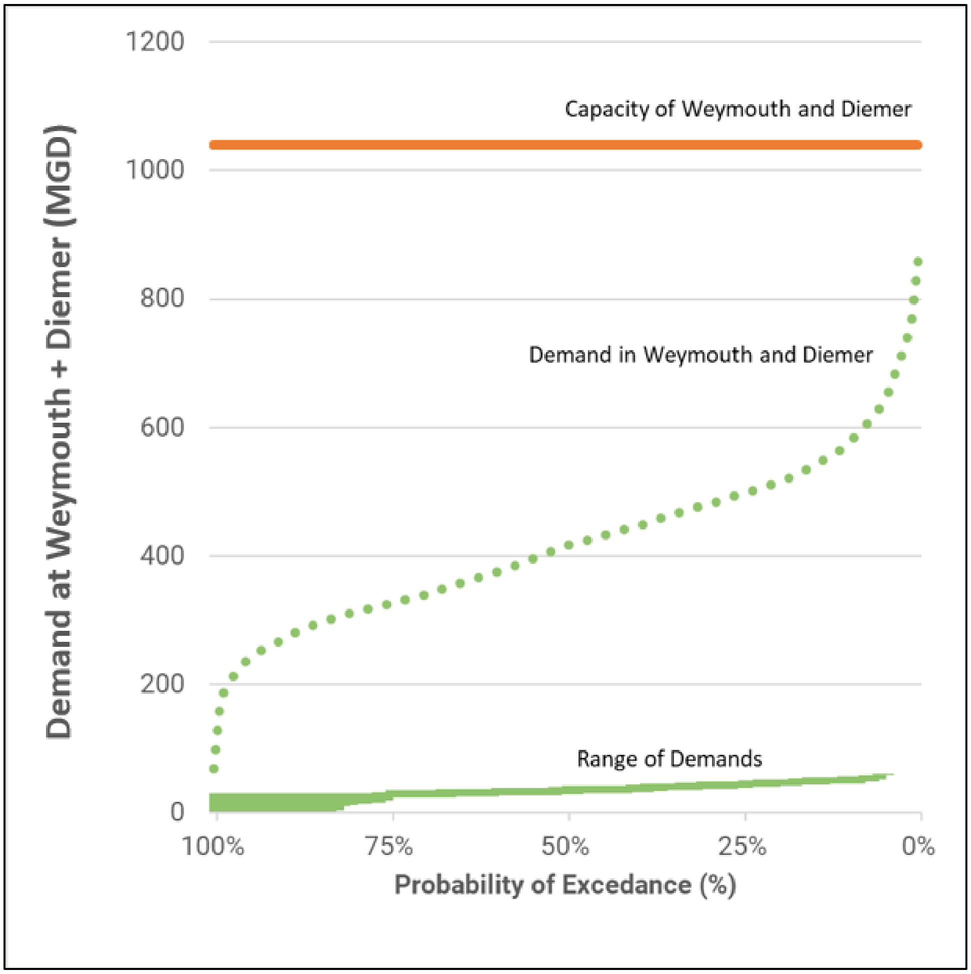


Figure 4-5: Probability of Exceedance from New Sources into Weymouth Plant

Treated Water Augmentation

The following assessment considers two potential locations to connect to Metropolitan's treated water system: 1) SLF at VXF and 2) MF at the 605 freeway/Ramona Blvd. based on the preliminary feeder screening discussed in the previous section. This analysis does not account for water quality concerns arising from the introduction of purified water into the distribution system. Hydraulic analysis will be performed later to confirm the information provided herein. The hydraulic analysis will review operating conditions and service connections impacted by the introduction of TWA, including extreme cases that factor in minimum sustainable flows from MF, LF, SLF, and PVF.

Second Lower Feeder at Victoria Cross Feeder Connection

The SLF is 78-inch diameter at this location and has a maximum capacity of approximately 330 cfs (213 MGD). The service connections served by the SLF are provided in Figure 4-6 where the available demand was calculated using the following formula:

- Demand available = Demand served by SLF – Reduction in demand available if any of the treatment plants are below their minimum sustainable level

In addition to the area identified in Figure 4-6, TWA water may be able to reach Jensen plant once the drought project (e.g. SLF retrofit and Venice Sepulveda Pump Station) are online.

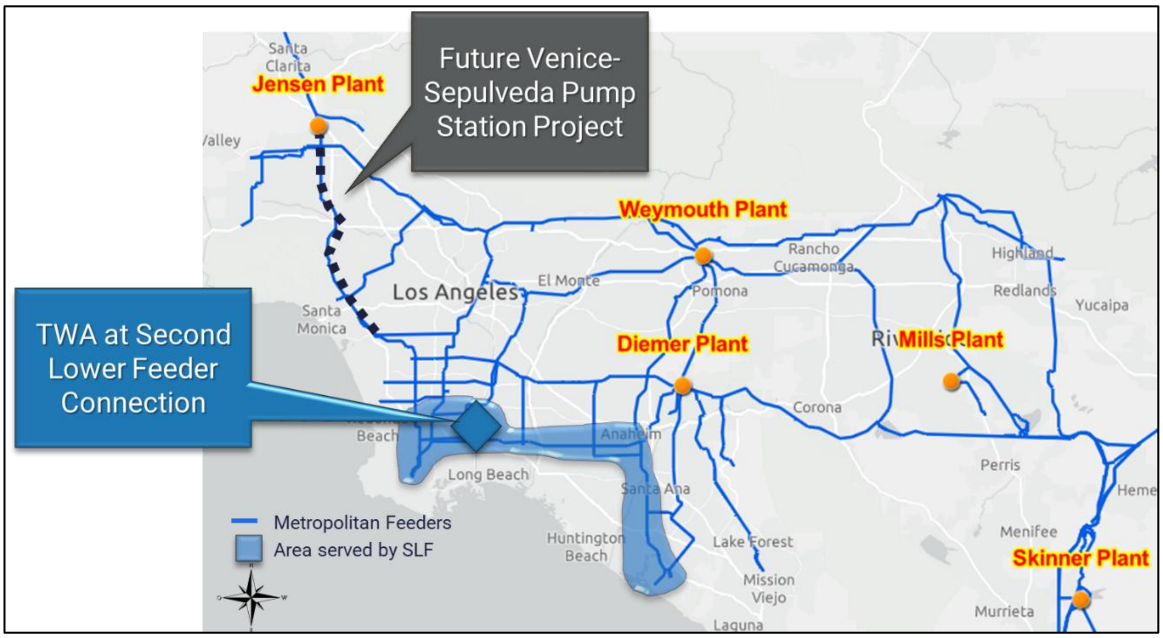


Figure 4-6: Service Connections Served by Second Lower Feeder (SLF)

Figure 4-7 shows the range of demands in the model for TWA from the SLF in the blue bars. It includes the probability of exceedance (i.e. probability that the TWA demand will be higher than the data shown) for the range of these demands. As shown in Figure 4-7, the range of TWA demand at the SLF is from 0 to 100 MGD.

As IPR demands increase to as high as 150 MGD, the range for RWA may reach 0 up to 20 percent of the time. Most of the time (>70 percent of the time), the range in TWA demand at the SLF ranges from 30 to 75 MGD – this represents the most likely range for the development of scenarios in the following sections.

The blue dashed line shows the range in historical demands for the service connections served by the SLF. The demands in the SLF range from 0 mgd to about 600 mgd. The orange line shows the capacity of the SLF at the Victoria Cross Feeder of 213 mgd. The median potential deliveries to the SLF is 45 mgd.

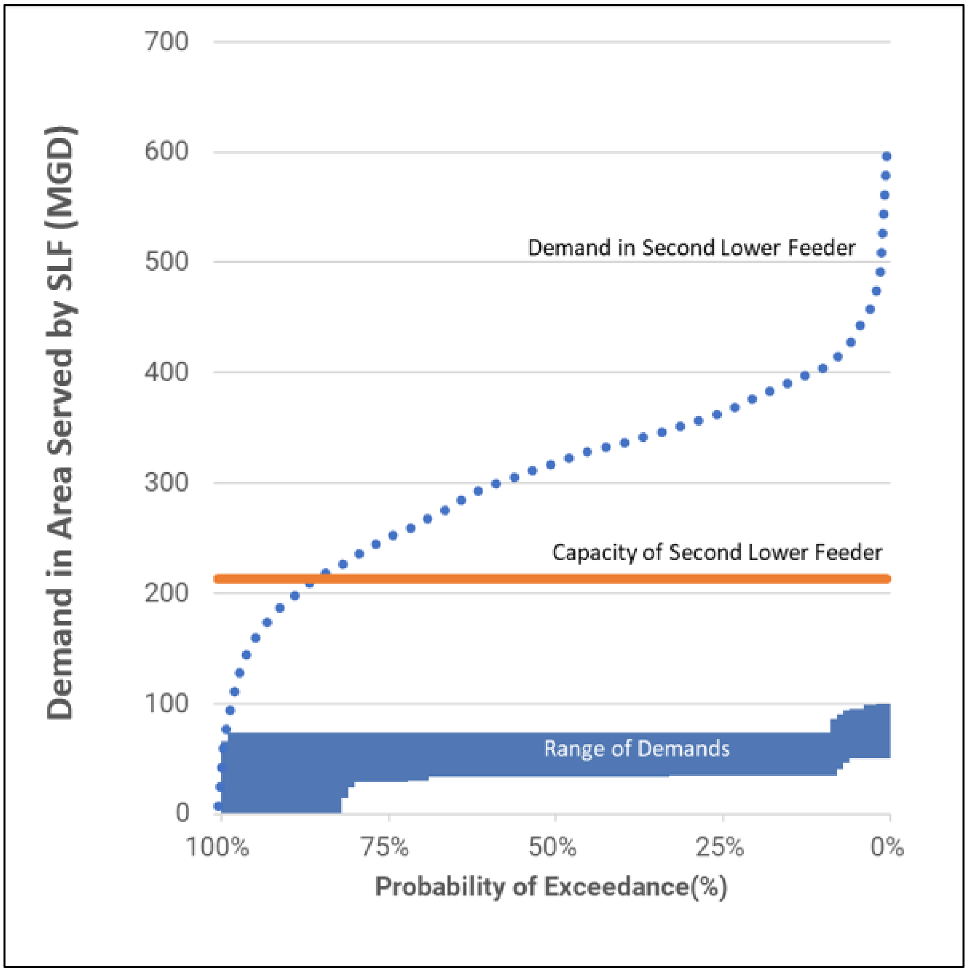


Figure 4-7: Probability of Exceedance from New Sources into Treated Water Feeders (Second Lower Feeder)

Middle Feeder at the 605 Freeway Connection/Ramona Blvd.

The Middle Feeder is a 72-inch diameter pipeline and has a capacity of 250 cfs (162 MGD) at the potential connection to the Backbone Pipeline. The demand available was calculated using the following formula:

- **Demand available** = Demand served by MF & Garvey – Reduction in demand available if any of the treatment plants are below their minimum sustainable level

If purified water is delivered to the MF, it could be stored in Garvey Reservoir and further distributed to a large portion in the Central Pool when Middle Feeder South is hydraulically connected to the Lower Feeder. Garvey would also provide a buffer for regulatory purposes. In addition to the area identified in **Figure 4-8**, purified water may be able to reach the Jensen plant once the drought projects (e.g. SLF retrofit and Venice-Sepulveda Pump Station) are online. Operations staff may also isolate the two feeders to push a higher grade within Central Pool, which would potentially reduce the extent of the area served by Garvey.

Figure 4-9 shows the range of demands in the model for TWA from the MF. It includes the probability of exceedance (i.e. probability that the TWA demand will be higher than the data shown) for the range of these demands in blue. As shown in Figure 4-9, the range of TWA demand at the MF is from 5 to 100 MGD. The blue dashed line shows the demands potentially served by the MF, which are substantially lower than the SLF with a range from 0 to 170 mgd. The capacity of the MF at the proposed connection point near the 605 freeway is 162 mgd. Because the expected flow in the MF is lower than the SLF, higher blends are expected.

As IPR demands increase to as high as 150 MGD, the range for RWA may reach 0 up to 20 percent of the time. Most of the time (>80% of the time), the range in TWA demand at the SLF ranges from 20 MGD to 75 MGD – this represents the most likely range for the development of scenarios in the following sections. The median for the range of potential deliveries to the MF is 60 MGD.

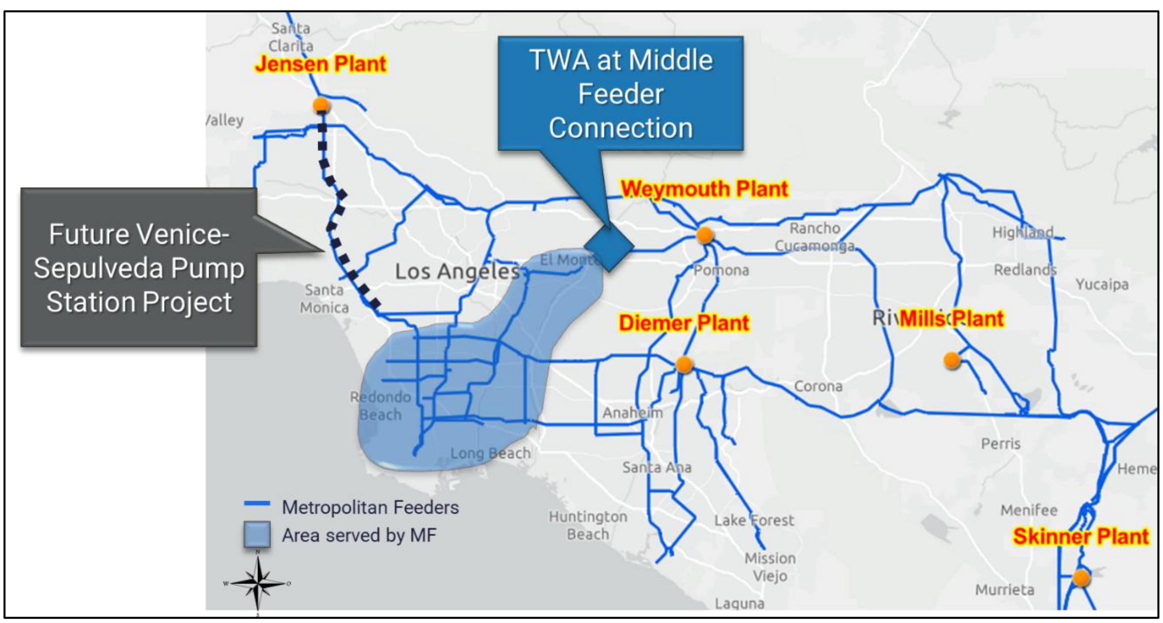


Figure 4-8: Service Connections Served by Middle Feeder (MF)

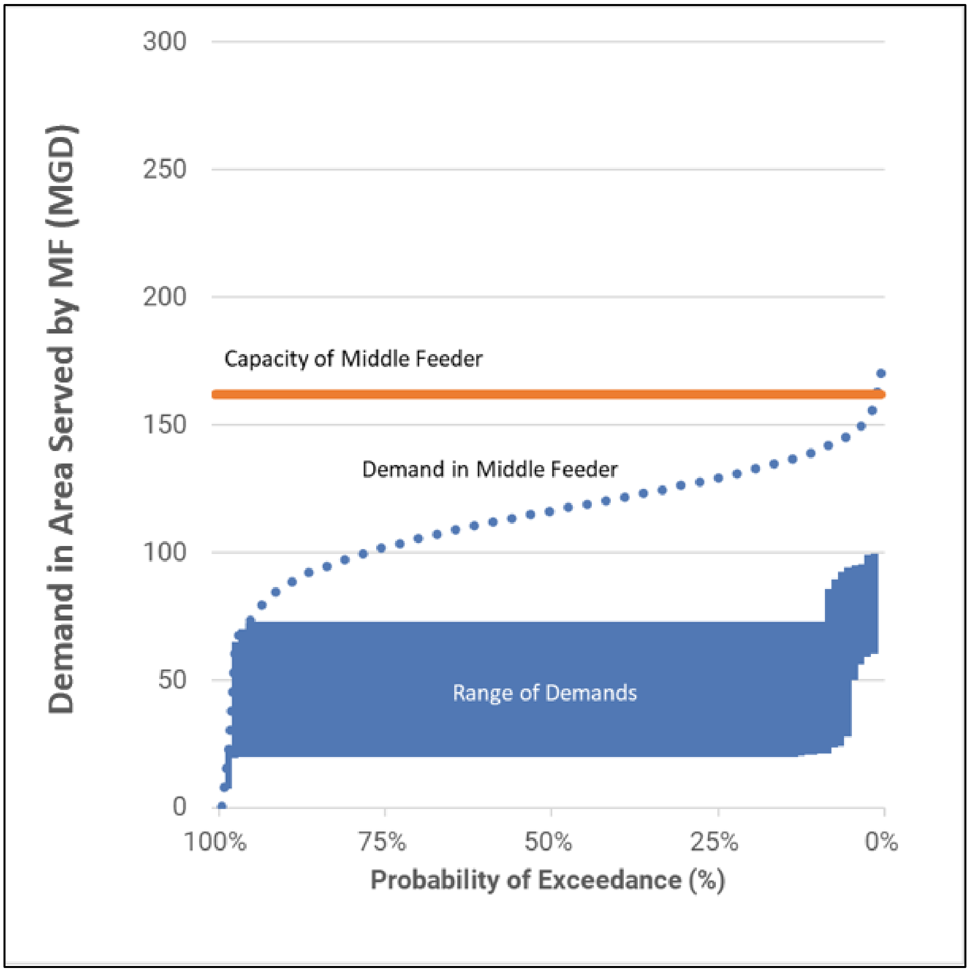


Figure 4-9: Probability of Exceedance from New Sources into Treated Water Feeders (Middle Feeder)

Figure 4-11 shows the projected flows from Weymouth, Diemer, and Jensen plants with PWSC implementation based upon the model assuming the maximum TWA in the model shown in Figure 4-8. This analysis incorporates the minimum sustainable flow at each of the treatment plants. With PWSC, flow is estimated to decrease by 6 percent at the Jensen plant, 16 percent at the Diemer plant, and up to 10 percent at the Weymouth plant. This analysis demonstrates that with PWSC the treatment plants will continue to operate above their minimum sustainable flows.

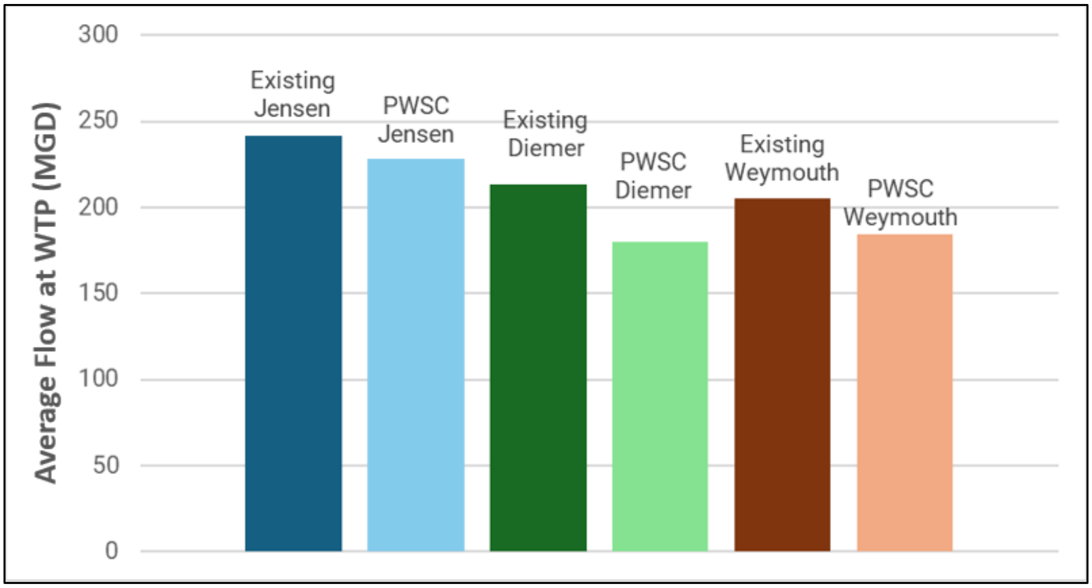


Figure 4-10: Modeled Flows at Three Metropolitan Plants with PWSC

Both TWA options have sufficient demand available to accommodate the range of TWA modeled as shown in both figures. The median available in the SLF is 317 MGD, which is higher than the maximum of 100 MGD in the model. Similarly, the median available in the MF is 75 MGD, which is higher than the maximum of 100 MGD. Therefore, there is sufficient demand available to accommodate the scenarios as modeled. However, blends at the MF are expected to be higher due to the lower flow potentially served by the MF. Again, additional hydraulic and water quality analyses are necessary to confirm these numbers.

Error! Reference source not found. shows the range in IPR (shown in light blue), RWA (shown in green), and TWA (shown in dark blue) based upon the model results. IPR deliveries would range from 50-150 MGD and have priority for delivery. RWA would range from 0 to 60 MGD and is constrained by the capacity of the DPR pipeline. TWA would range from 0 to 100 MGD, constrained by the IPR demands.

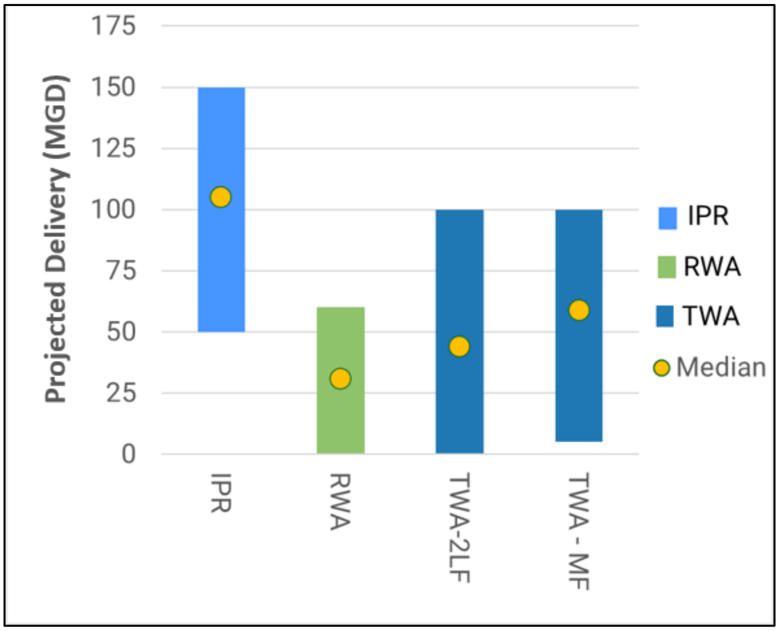


Figure 4-11: Projected Delivery for IPR and DPR

4.3 Data Analytics

4.3.1 Outliers

The data from the model output for each scenario was scrubbed for outliers using the 1.5 interquartile range (IQR) rule. The 1.5 IQR rule is a common statistical method used to identify outliers in a dataset. It works by calculating a range, or fence, around the data's IQR. The IQR is the difference between the 75th (Q3) and 25th (Q1) percentiles. Therefore, the upper fence is calculated as Q3+ 1.5*IQR, while the lower fence is calculated as Q1–1.5*IQR. Anything outside of those fences is considered an outlier and was not used in the calculations. These fences are used to identify a reasonable maximum and minimum, and don't typically affect the median or mean of the dataset.

4.3.2 Online Percentage

The online goal for PWSC is 92 percent. The online percentage is calculated for each scenario considering the probability of achieving the target production of 150 MGD. For example, if a scenario produces less than 150 MGD at 25 percent of the time, the online percentage would be 75 percent and would not meet the target. The minimum flow requirement through the AWPF at 150 MGD is 60 MGD. The online goal above the minimum flow requirement through the AWPF is 99 percent.

4.3.3 Median Blend Percentage

For each day in the model for RWA and TWA, an estimated blend percentage is calculated based upon the flow at Weymouth and/or Diemer plant for RWA, or within each feeder for TWA. Blend percentage is calculated as:

RWA Blend Percentage = RWA Deliveries/(Demand at Weymouth - RWA Deliveries).

TWA Blend Percentage = TWA Deliveries/(Demand Served by SLF/MF –TWA Deliveries)

The median blend percentage for the design flow for each alternative is equal to the median blend percentage for the entire dataset for that alternative. For the max IPR condition or max RWA/TWA condition, the median blend percentage is calculated only on the data for the specific RWA or TWA condition. For example, if under the IPR max condition, the max IPR is equal to 120 MGD and the associated RWA is equal to 30 MGD, then only data where the RWA is equal to 30 MGD were used in the calculation of the medians.

4.3.4 Priority for Member Agency Demands

The model's analysis prioritizes member agency demands for non-potable water and groundwater replenishment. DPR demands for RWA and TWA would be secondary for all scenarios unless indicated (e.g., for some scenarios, IPR is limited to a maximum number, so IPR may not be fully met). The PWSC system would therefore peak off the RWA and TWA systems. During an earthquake event, RWA or TWA would be prioritized to maximize deliveries to the system and reducing the replenishment deliveries to the member agencies.

Section 5: Potential DPR Implementation Scenarios

This TM intends to have a comprehensive assessment of all potential DPR implementation approaches that are feasible for PWSC. Several DPR implementation scenarios (shown in **Figure 5-1**) were developed based on the following considerations and findings from the evaluation of Metropolitan's existing infrastructure that could be used for DPR applications:

- Achieve ultimate buildout of 150 MGD
- Consider both RWA and TWA options
- Maximize the online factor to achieve the desired 92% target
- Assume MBR effluent nitrate level of 19 mg/L as N for additional IPR and DPR treatment with 2.0 mg/L as N target for RWA and 0.9 mg/L as N target for TWA
- Maximize water supply reliability during emergency events
- Minimize the number of treatment locations
- Consider both default and alternative DPR treatment train options
- Leverage reservoirs as engineered buffers
- Reduce the extent and/or size of the backbone pipeline and/or DPR pipeline
- Reduce pumping costs by optimizing the number and placement of pump stations
- Consider hydraulics, operations, maintenance, water quality, and compliance challenges

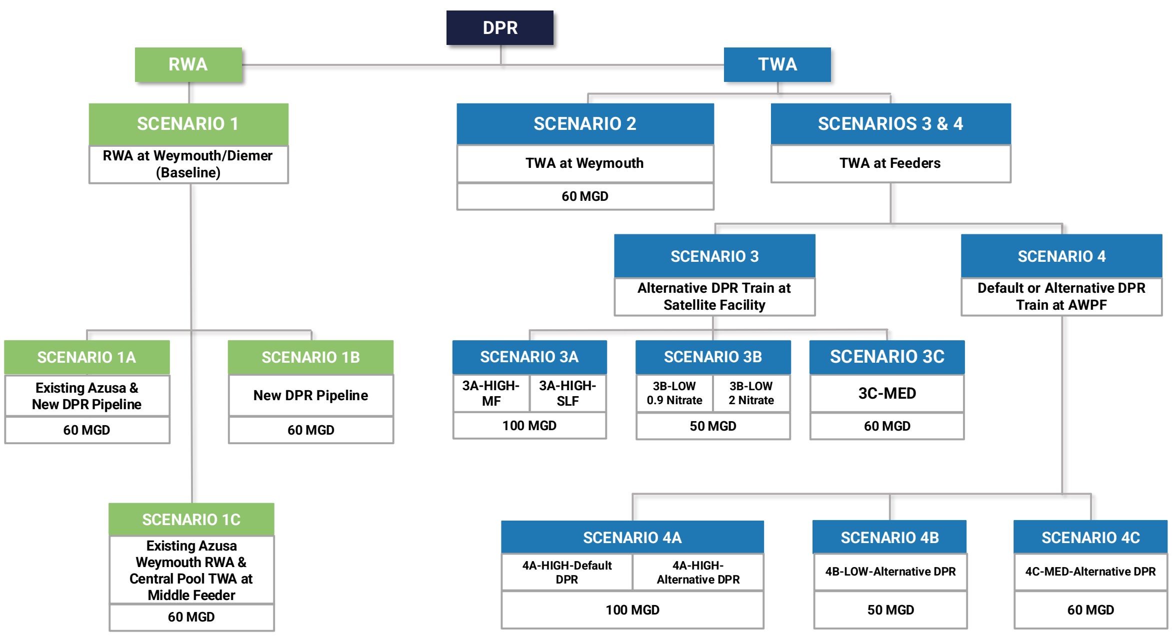


Figure 5-1: DPR Implementation Scenarios for 150 MGD PWSC (Seasonal peak demands are presented)

Treatment and conveyance requirements for each DPR implementation scenario are summarized in **Table 5-1**. DPR applications are color coded, green for RWA and blue for TWA, throughout this TM.

Table 5-1: DPR Implementation Scenarios

DPR Type	DPR Location	Scenario	DPR Connection Point	DPR and IPR Prioritization	DPR Maximum Demand (MGD)	DPR Median Demand (MGD)	IPR Connection Point	Treatment Infrastructure Requirement	Nitrate in Purified Water (mg/L)	Pumping Station (PS) Requirement	Pipeline Infrastructure Requirements	Identifier
RWA	Weymouth RWA DPR Treatment at Satellite Facility	1A	Near Weymouth Raw Water Junction Structure	IPR demands are maximized and met.	60	30	Canyon Spreading Grounds (Canyon)	IPR Train at AWPF RWA Alternative Train at Satellite	2	AWPF PS Whittier Narrows PS Santa Fe PS Canyon PS & Big Dalton PS DPR PS	84" Backbone Pipeline (37.4 miles) – Reach 1 through 8A 48" Backbone Pipeline (1.7 miles) - Reach 8B (i.e., SFSG to Canyon) 30" Azusa Pipeline (3.1 miles of improvements) 54" DPR Pipeline (12 miles)	1A-LOW-WEY-IPR TRAIN & ALT DPR-2N
		1B	Near Weymouth Raw Water Junction Structure	IPR demands are maximized and met.	60	40	Santa Fe Spreading Grounds (SFSG)	IPR Train at AWPF RWA Alternative Train at Satellite	2	AWPF PS Whittier Narrows PS Santa Fe PS DPR PS	84" Backbone Pipeline (37.4 miles) 54" DPR Pipeline (12 miles)	1B-LOW-WEY-IPR TRAIN & ALT DPR-2N
		1C	Weymouth Finished Water Reservoir/Middle Feeder	IPR demands are maximized and met.	60	30	Canyon Spreading Grounds (Canyon)	IPR Train at AWPF RWA Alternative Train at Satellite TWA Alternative Train at Satellite	0.9	AWPF PS Whittier Narrows PS Santa Fe PS Canyon PS & Big Dalton PS	84" Backbone Pipeline (37.4 miles) – Reach 1 through 8A 48" Backbone Pipeline (1.7 miles) - Reach 8B (i.e., SFSG to Canyon) 30" Azusa Pipeline (3.1 miles of improvements)	1C-LOW-WEY-IPR TRAIN & ALT DPR-0.9N
TWA	Weymouth TWA DPR Treatment at Satellite Facility	2	Weymouth Finished Water Reservoir/Middle Feeder	IPR demands are maximized and met.	60	40	SFSG	IPR Train at AWPF TWA Alternative Train at Satellite	0.9	AWPF PS Whittier Narrows PS Santa Fe PS DPR PS	84" Backbone Pipeline (37.4 miles) 54" DPR Pipeline (12 miles)	2-LOW-WEY RSVR-IPR TRAIN & ALT DPR-2N
	Central Pool TWA DPR Treatment at Satellite Facility	3A-HIGH-MF	Middle Feeder (MF)	DPR demands are maximized. IPR demands are limited to 75 MGD	100	75	SFSG	IPR Train at AWPF TWA Alternative Train at Satellite	0.9	AWPF PS MF Satellite Booster PS Whittier Narrows PS	Backbone Pipeline (37.4 miles total; 90": 5.9 mi, 78": 25.7 mi, 54": 5.8 mi)	3A-HIGH-MF-IPR TRAIN & ALT DPR-0.9N
		3A-HIGH-SLF	Second Lower Feeder (SLF)	DPR demands are maximized. IPR demands are limited to 75 MGD	100	75	SFSG	IPR Train at AWPF TWA Alternative Train at Satellite	0.9	AWPF PS SLF Satellite Booster PS Whittier Narrows PS	Backbone Pipeline (37.4 miles total; 90": 4.3 mi, 66": 1.6 mi, 54": 31.5 mi)	3A-HIGH-SLF-IPR TRAIN & ALT DPR-0.9N
		3B-LOW-0.9N	SLF	IPR demands are maximized and met.	50	35	Canyon	IPR Train at AWPF TWA Alternative Train at Satellite	0.9	AWPF PS SLF Satellite Booster PS Whittier Narrows PS Santa Fe PS	Backbone Pipeline (39.1 miles total; 90": 4.3 mi, 78": 1.6 mi, 66": 12 mi, 54": 19.5 mi, 48": 1.7 mi)	3B-LOW-SLF-IPR TRAIN & ALT DPR-0.9N
		3B-LOW-2N	SLF	IPR demands are maximized and met.	50	35	Canyon	IPR Train at AWPF TWA Alternative Train at Satellite	2	AWPF PS SLF Satellite Booster PS Whittier Narrows PS Santa Fe PS	Backbone Pipeline (39.1 miles total; 90": 4.3 mi, 78": 1.6 mi, 66": 12 mi, 54": 19.5 mi, 48": 1.7 mi)	3B-LOW-SLF-IPR TRAIN & ALT DPR-2N
		3C-MED	SLF	IPR and DPR demands are optimized. IPR demands are limited to 105 MGD	60	45	SFSG	IPR Train at AWPF TWA Alternative Train at Satellite	0.9	AWPF PS SLF Satellite Booster PS Whittier Narrows PS	Backbone Pipeline (37.4 miles total; 90": 4.3 mi, 78": 1.6 mi, 54": 31.5 mi)	3C-MED-SLF-IPR TRAIN & ALT DPR-0.9N
	Central Pool TWA DPR Treatment at AWPF	4A-HIGH-Default DPR	SLF	DPR demands are maximized. IPR demands are limited to 75 MGD	100	75	SFSG	Single Default Train at AWPF for DPR and IPR	0.9	AWPF PS SLF PS Whittier Narrows PS	Single pipeline serving DPR and IPR demands (37.4 miles total; 84": 4.3 mi, 66": 1.6 mi, 54": 31.5 mi)	4A-HIGH-SLF-SINGLE PIPE-SINGLE DFLT DPR TRAIN-0.9N
		4A-HIGH-Alternative DPR	SLF	DPR demands are maximized. IPR demands are limited to 75 MGD	100	75	SFSG	IPR Train at AWPF TWA Alternative Train at AWPF	0.9	AWPF IPR PS AWPF DPR PS SLF PS Whittier Narrows PS	Separate DPR and IPR Pipelines (IPR: 37.4 miles total; 78": 5.9 mi, 66": 2.9 mi, 54": 28.6 mi DPR: 78": 5.3 mi)	4A-HIGH-SLF-DUAL PIPE-IPR TRAIN & ALT DPR-0.9N
		4B-LOW-Alternative DPR	SLF	IPR demands are maximized and met.	50	35	Canyon	IPR Train at AWPF TWA Alternative Train at AWPF	0.9	AWPF IPR PS AWPF DPR PS SLF PS Whittier Narrows PS Santa Fe PS	Separate DPR and IPR Pipelines (IPR: 39.1 miles total; 78": 5.9 mi, 66": 17.5 mi, 54": 14 mi, 48": 1.7 mi DPR: 54": 5.3 mi)	4B-LOW-SLF-DUAL PIPE-IPR TRAIN & ALT DPR-0.9N
		4C-MED-Alternative DPR	SLF	IPR and DPR demands are optimized. IPR demands are limited to 105 MGD	60	45	SFSG	IPR Train at AWPF TWA Alternative Train at AWPF	0.9	AWPF IPR PS AWPF DPR PS SLF PS Whittier Narrows PS	Separate DPR and IPR Pipelines (IPR: 37.4 miles total; 78": 5.9 mi, 54": 31.5 mi DPR: 54": 5.3 mi)	4C-MED-SLF-DUAL PIPE-IPR TRAIN & ALT DPR-0.9N

[1] To serve Weymouth and Diemer demands; [2] With buffer/storage at Garvey Reservoir (via Middle Feeder); [3] Potential Long Beach DPR Demand currently not included, could result in additional 19 MGD DPR capacity.

5.1 Scenario 1: Weymouth RWA

Scenario 1 assumes a total of 60 mgd of RWA (above 10% DPR blend at 60 MGD Seasonal Peak) would be implemented at the Weymouth plant, with flexibility to augment Diemer plant raw water supplies. The analysis assumes the backbone pipeline would be constructed as planned, serving IPR demands along the backbone pipeline. Three subsets are considered:

- Scenario 1A – The SGVMWD's existing Azusa Pipeline would be used to convey up to 25 MGD to the Weymouth plant, and a new DPR pipeline would be constructed from the Santa Fe Pump Station eastward to the Weymouth plant to convey an additional 35 MGD for RWA. This would be the baseline scenario.
- Scenario 1B – All RWA supply of up to 60 MGD would be conveyed to Weymouth via a single larger DPR pipeline.
- Scenario 1C – A hybrid scenario that combines Weymouth RWA (25 MGD) conveyed through the existing Azusa Pipeline with TWA (35 MGD) at Middle Feeder.

The RWA connection would be adjacent to the Weymouth plant's Junction Structure. A satellite facility for DPR treatment would be required. Figure 5-2, Figure 5-3 and Figure 5-4 illustrate Scenarios 1A, 1B and 1C, respectively. These scenarios do not allow for any reduction in size and length of the backbone pipeline along various reaches or segments.

Scenario 1C would require two satellite treatment facilities: one targeting RWA-level treatment and the other utilizing alternative DPR treatment train, Although this scenario is not evaluated further in this TM, it represents a feasible approach that could avoid the need for a new DPR pipeline to Weymouth and leverage the existing Azusa pipeline and a less than 10% blend at Weymouth. Evaluation of satellite facility locations would be needed based on technical, operational, and site constraints before finalizing the DPR implementation strategy. Additional evaluation of Scenario 1C could be conducted at Metropolitan's direction.

Purified water delivered from the AWPF would contain approximately 4 mg/L of nitrate. Achieving a nitrate target of 2 mg/L for RWA would require a partial two-pass RO system (with bypass). Similarly, a boron target of 0.57 mg/L has been established, as described in Section 2.4. Both nitrate and boron targets would govern the RO treatment sizing criteria.

For easier identification, pipeline sizes are designated by color. Potential service connections to be served along the backbone pipeline are listed in **Table 5-2** below.

Table 5-2: Potential Service Connections along Backbone Pipeline

Service Connection (SC)	Member Agency
SC-1	Los Angeles Department of Water and Power
SC-2	West Basin
SC-3	Long Beach
SC-4	Central Basin
SC-5	Upper Water/Three Valleys
SC-6	
SC-7	
SC-8	
SC-9	San Gabriel Valley MWD

The following terms are used for all scenario figures/tables in this section:

"Design Flow" for IPR and DPR is determined based on the median demand estimated by Metropolitan's operational model

“**Maximize IPR**” represents purified water use during dry years, aiming to maximize groundwater recharge.

“**Maximize DPR**” represents purified water use during emergencies (e.g., seismic events), when State Water Project allocation (SWP) is low or Colorado River Aqueduct (CRA) supply is low, or other periods when IPR demand is low.

Figure 5-2: Scenario 1A–Weymouth RWA via Existing Azusa (25 MGD) and New DPR (35 MGD) Pipelines

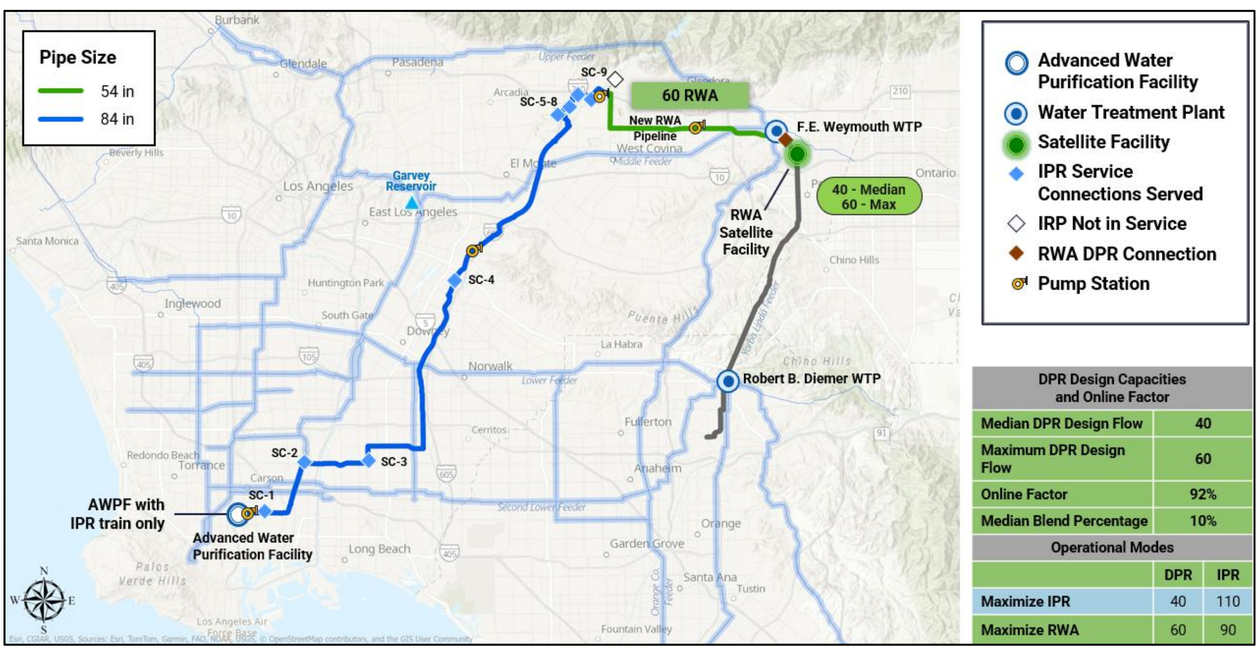
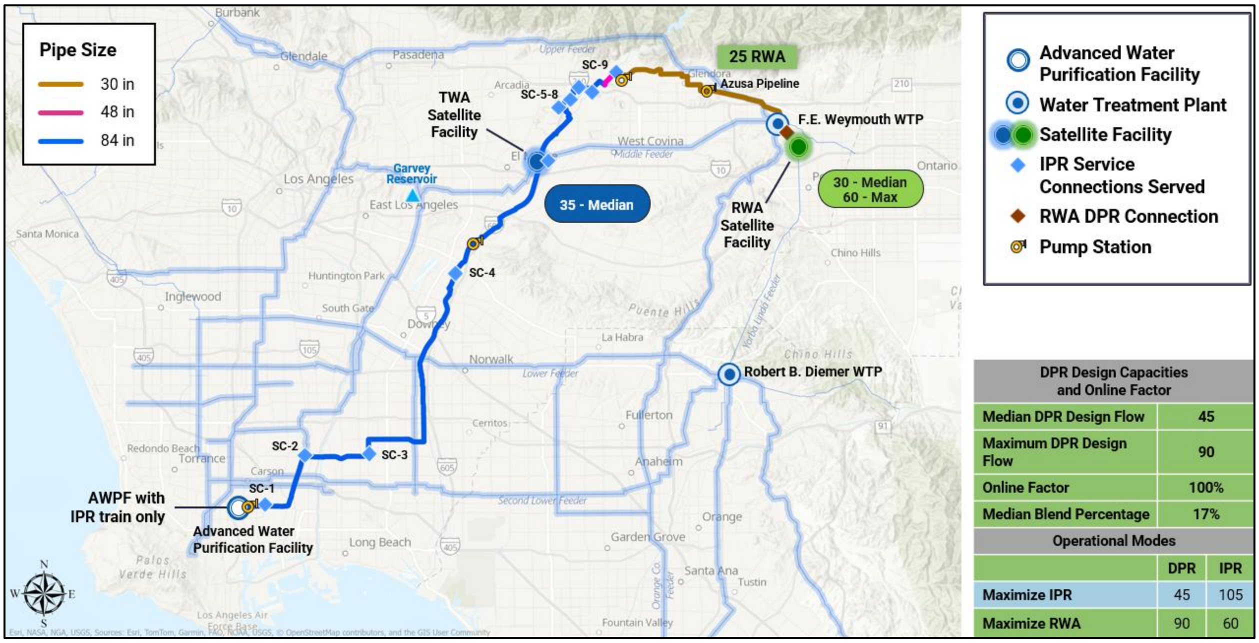


Figure 5-3: Scenario 1B–Weymouth RWA via New DPR Pipeline (60 MGD)

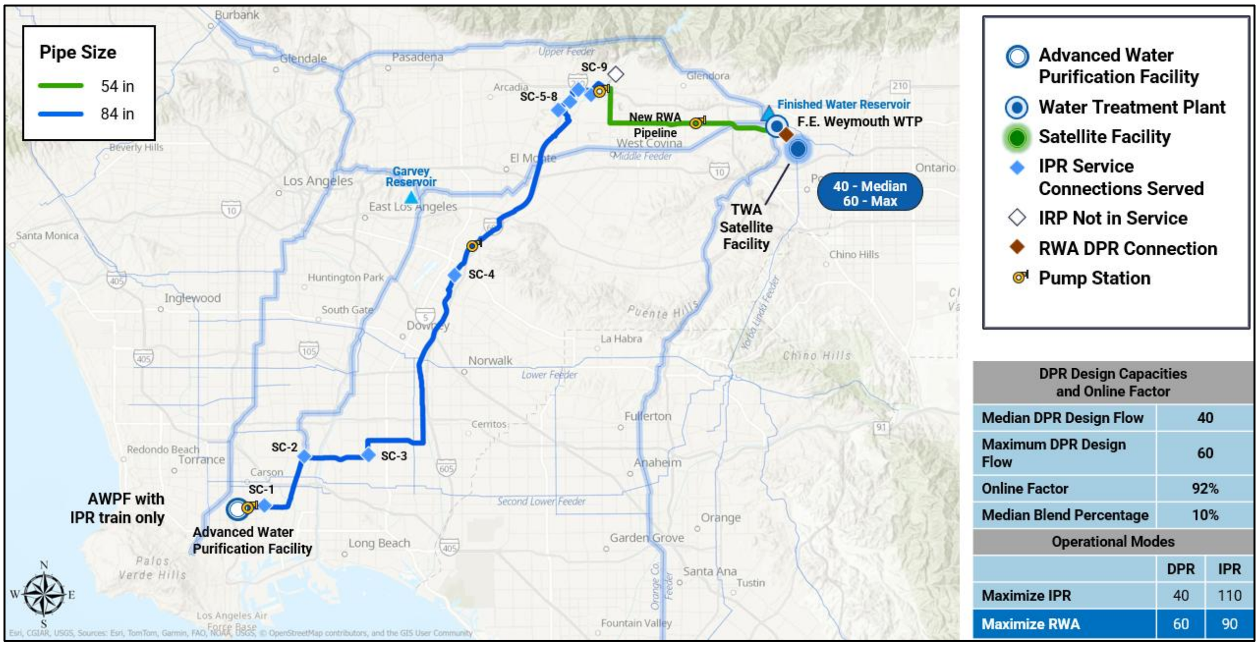


DPR Design Capacities and Online Factor		
Median DPR Design Flow	45	
Maximum DPR Design Flow	90	
Online Factor	100%	
Median Blend Percentage	17%	
Operational Modes		
	DPR	IPR
Maximize IPR	45	105
Maximize RWA	90	60

Figure 5-4: Scenario 1C - Weymouth RWA (via Azusa) and TWA at Middle Feeder

5.2 Scenario 2: Weymouth TWA

Scenario 2 considers implementing TWA for 40 MGD median and 60 MGD seasonal peak with a direct connection to the Weymouth FWR. A new DPR pipeline would be constructed to convey flows to a satellite treatment facility near/at the Weymouth plant, with IPR demands supplied along the backbone pipeline, as illustrated in **Figure 5-5**. The FWR is normally operated in a flow through mode, offering limited storage capacity for purified water. However, as discussed in Section 3, a TWA connection to the Weymouth FWR could provide the desired engineered buffer for TWA operations via the Middle Feeder to access demands in the Central Pool area. Demands in the other connected feeders can also be served. Purified water delivered from AWPF is estimated to contain 4 mg/L of nitrate. To meet Metropolitan's internal TWA nitrate goal of 0.9 mg/L, a partial two-pass RO system (with bypass) would be needed.



DPR Design Capacities and Online Factor		
Median DPR Design Flow	40	
Maximum DPR Design Flow	60	
Online Factor	92%	
Median Blend Percentage	10%	
Operational Modes		
	DPR	IPR
Maximize IPR	40	110
Maximize RWA	60	90

Figure 5-5: Scenario 2 - Weymouth TWA (60 MGD)

5.3 Scenario 3: TWA at Feeders Using Satellite DPR Treatment

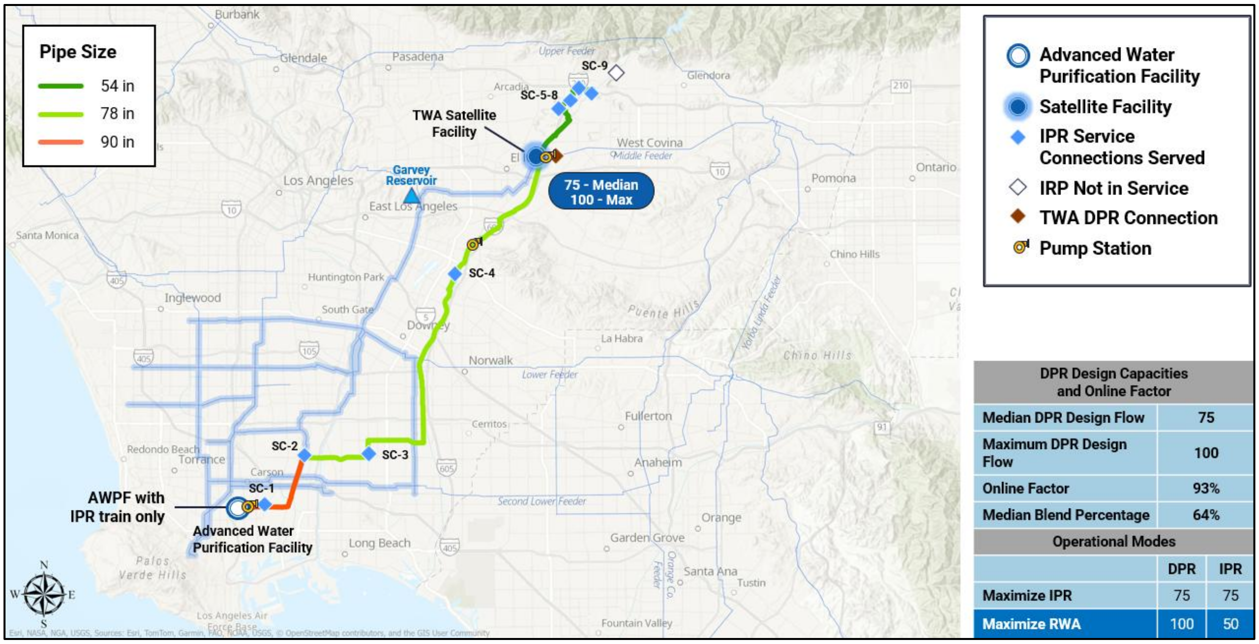
Under Scenario 3, the analysis assumes a satellite DPR treatment facility would be constructed near the DPR connection point at MF or SLF. The backbone pipeline would serve satellite facilities and IPR demands along the way. The pipeline length and sizing associated with the satellite facility would be based on the DPR demands, and backbone pipeline sizing would be based on the capacity of the satellite facility and the IPR service connection locations/demands. All IPR treatment takes place at the AWPF, while treatment at the satellite facilities would use an alternative DPR train. Several subsets for Scenario 3 have been developed based on the connecting feeder, demand variations, and nitrogen goals:

- **Scenario 3A-HIGH** – DPR demands are maximized, with IPR demands capped at 75 MGD. DPR capacities are estimated to be 75 MGD median and up to 100 MGD seasonal maximum. A satellite facility with an alternative DPR treatment train and feeder connection at MF or SLF will be utilized. A partial two-pass RO system is required to reduce nitrate levels to 0.9 mg/L and boron levels to 0.57 mg/L in the advanced treated water.

- Scenario 3A-HIGH-MF: Deliver 75 MGD median and 100 MGD seasonal maximum flow from the satellite facility to MF, with storage/buffer at Garvey Reservoir to serve MF demands. Additional pumping and conveyance would be required for purified water to reach the MF (as compared to the SLF). Demands in the other connected feeders can also be served from Garvey Reservoir.
- Scenario 3A-HIGH-SLF: Deliver 75 MGD median and 100 MGD seasonal maximum DPR flow to SLF from the satellite facility, which would be in the vicinity of West Basin's Carson Facility.

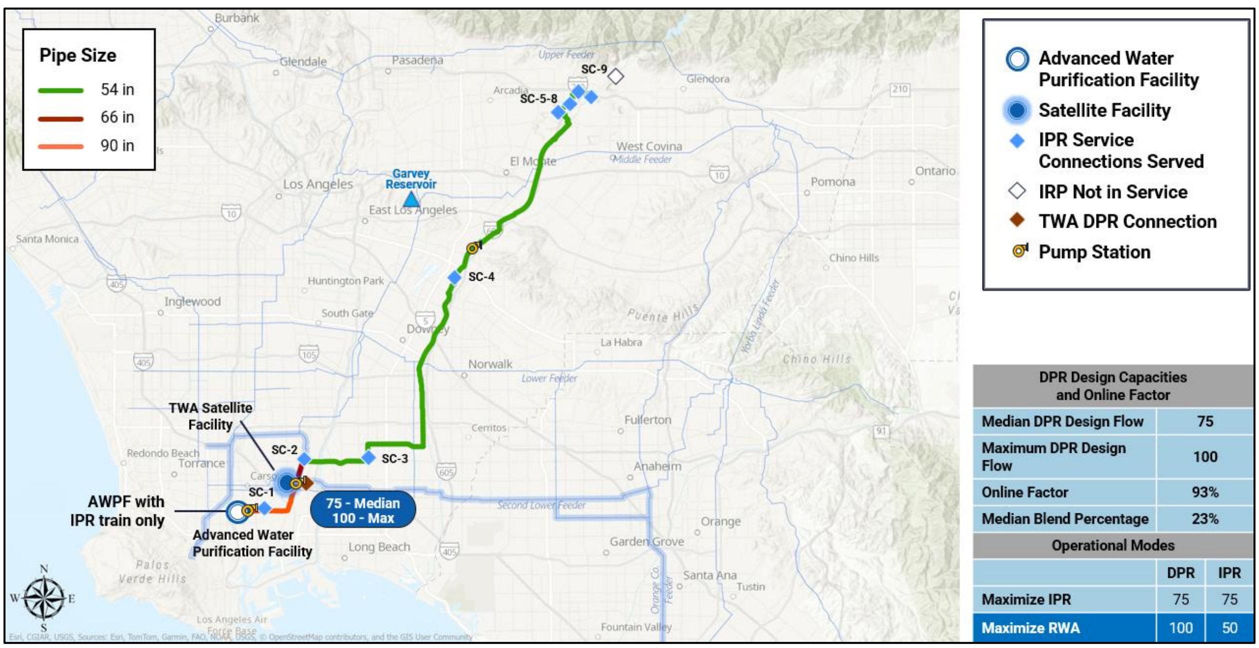
- Scenario 3B-LOW – IPR demands are maximized and met. DPR demands are estimated to be 35 MGD median and 50 MGD seasonal maximum. A satellite DPR treatment facility near SLF and a feeder connection at the SLF will be utilized. The following two sub-scenarios are developed to evaluate the nitrate compliance strategies discussed in Section 2.4.
    - 3B-LOW-SLF-0.9N: Under this scenario, the nitrate target is met only by treatment. Therefore, nitrate levels in the advanced treated water is targeted at 0.9 mg/L. A full two-pass RO (with no bypass) may be required to meet the 0.9 mg/L goal.
    - 3B-LOW-SLF-2N: If additional water supplies can be utilized for blending, advanced treated water nitrate level of 2 mg/L can be considered to meet the 0.9 mg/L target. A partial two-pass RO (with bypass) may be required to meet the 2 mg/L nitrate. Under this scenario, the nitrate target is met by treatment and blending.
- Scenario 3C-MED – A demand-optimized scenario was developed based on factors mentioned in Section 4 where IPR demands are limited to 105 MGD, resulting in a DPR demand of 45 MGD median and 60 MGD seasonal maximum. A satellite DPR treatment facility near SLF and a feeder connection at the SLF will be utilized. A partial two-pass RO system may be required to reduce nitrate levels to 0.9 mg/L in the advanced treated water.

Figure 5-6 through Figure 5-10 illustrate the sub-scenarios under Scenario 3. Given that TWA would be implemented in the Central Pool, the backbone pipeline could be incrementally reduced in diameter, which would result in infrastructure cost savings.



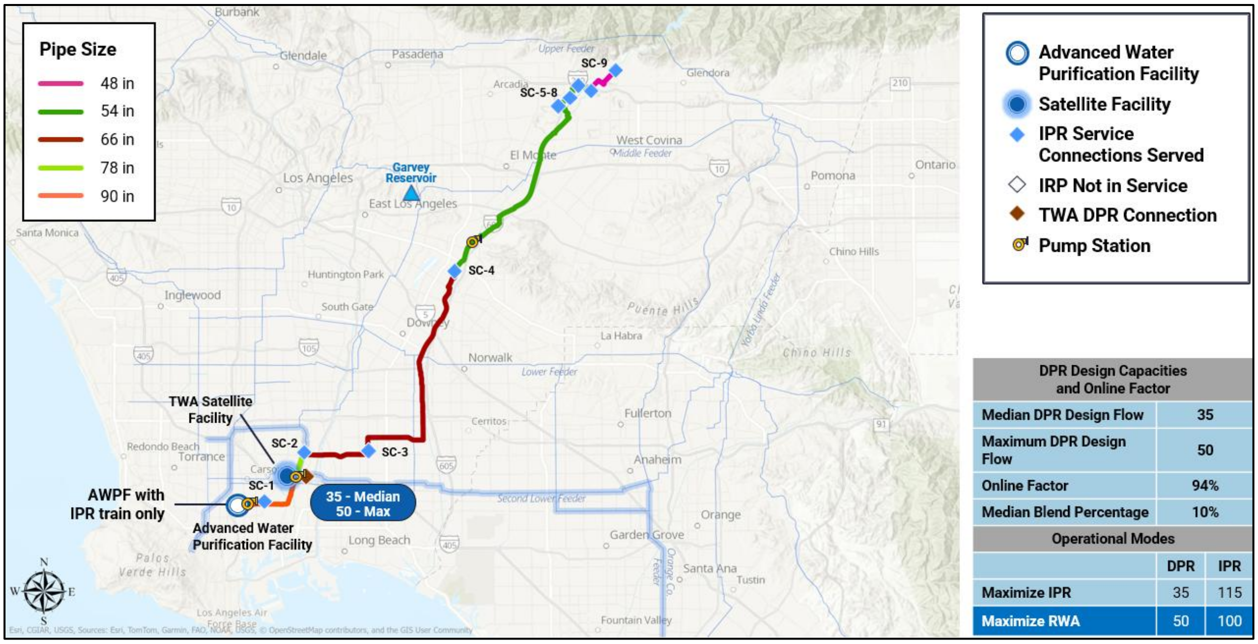
DPR Design Capacities and Online Factor		
Median DPR Design Flow	75	
Maximum DPR Design Flow	100	
Online Factor	93%	
Median Blend Percentage	64%	
Operational Modes		
	DPR	IPR
Maximize IPR	75	75
Maximize RWA	100	50

Figure 5-6: Scenario 3A–TWA at Feeders (100 MGD 3A-HIGH) at MF



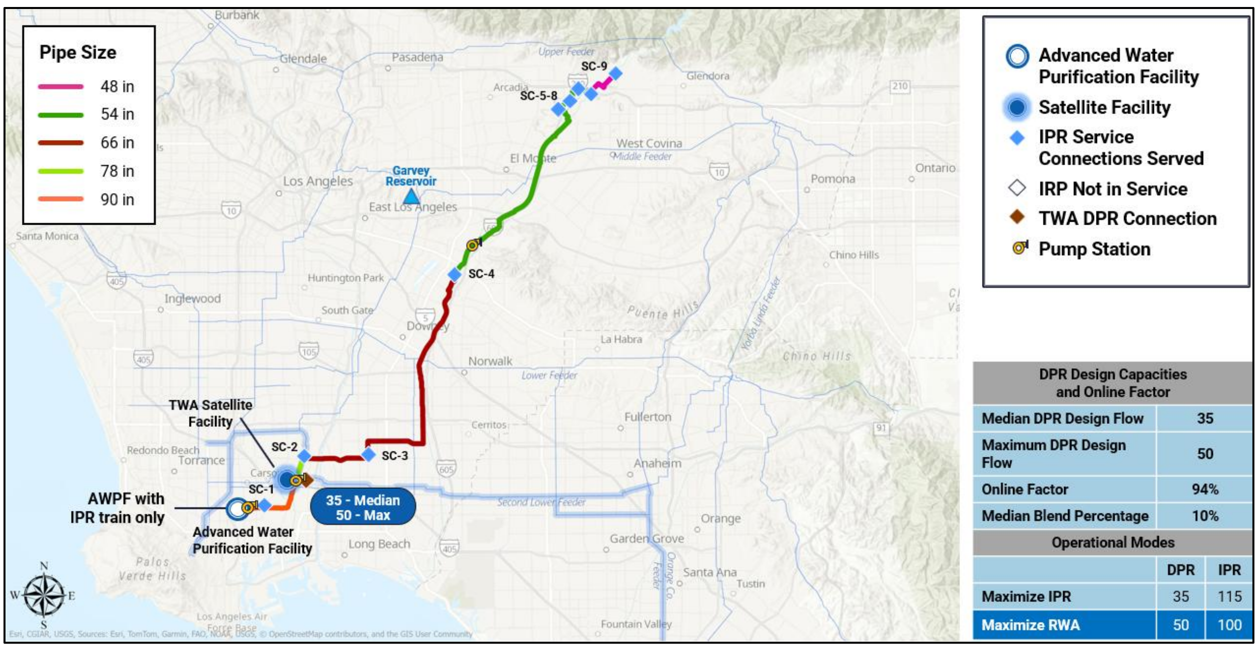
DPR Design Capacities and Online Factor		
Median DPR Design Flow	75	
Maximum DPR Design Flow	100	
Online Factor	93%	
Median Blend Percentage	23%	
Operational Modes		
	DPR	IPR
Maximize IPR	75	75
Maximize RWA	100	50

Figure 5-7: Scenario 3A–TWA at Feeders (100 MGD 3A-HIGH) at SLF



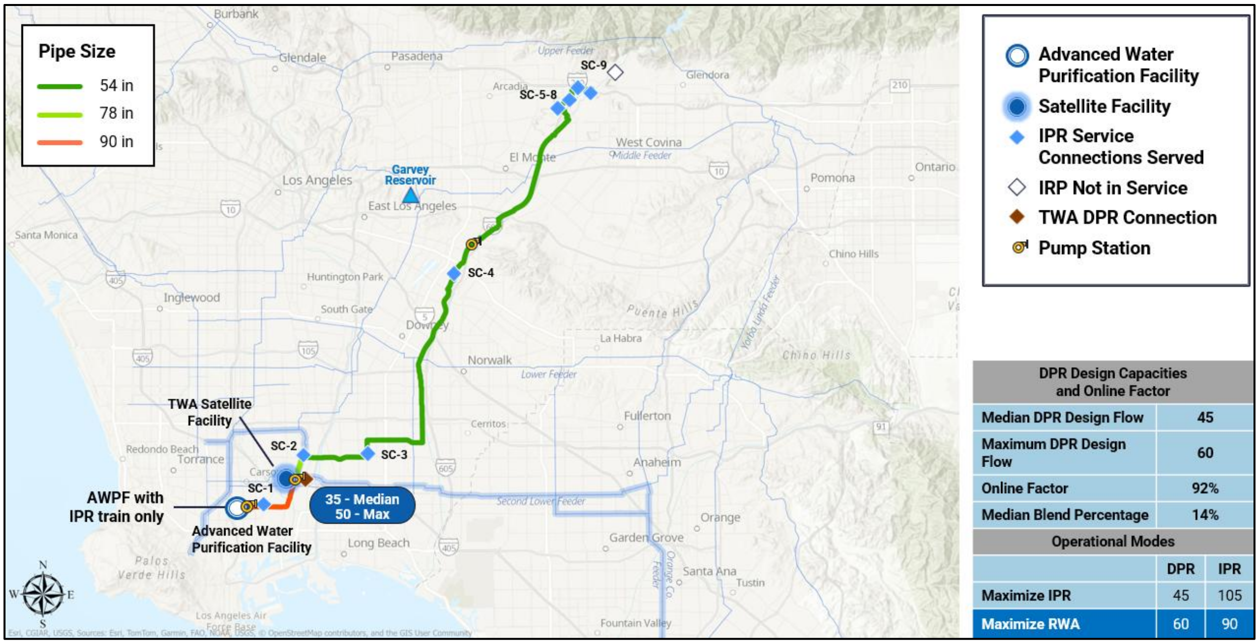
DPR Design Capacities and Online Factor		
Median DPR Design Flow	35	
Maximum DPR Design Flow	50	
Online Factor	94%	
Median Blend Percentage	10%	
Operational Modes		
	DPR	IPR
Maximize IPR	35	115
Maximize RWA	50	100

Figure 5-8: Scenario 3B-0.9N–TWA at Feeders (50 MGD - 3B-LOW) at SLF–Nitrate Compliance by Treatment



DPR Design Capacities and Online Factor		
Median DPR Design Flow	35	
Maximum DPR Design Flow	50	
Online Factor	94%	
Median Blend Percentage	10%	
Operational Modes		
	DPR	IPR
Maximize IPR	35	115
Maximize RWA	50	100

Figure 5-9: Scenario 3B-2N–TWA at Feeders (50 MGD - 3B-LOW) at SLF–Treatment and Blending for Nitrate Compliance



DPR Design Capacities and Online Factor		
Median DPR Design Flow	45	
Maximum DPR Design Flow	60	
Online Factor	92%	
Median Blend Percentage	14%	
Operational Modes		
	DPR	IPR
Maximize IPR	45	105
Maximize RWA	60	90

Figure 5-10: Scenario 3C– TWA at Feeders (60 MGD 3C-MED) at SLF

5.4 Scenario 4: TWA at Feeders Using the AWPF

Under Scenario 4, the analysis assumes DPR treatment would take place at the AWPF. The backbone pipeline length would be based on the available TWA connection point at the SLF and the IPR service connection locations/demands. There are three sub-scenarios associated with Scenario 4:

- Scenario 4A-HIGH– DPR demands are allocated at the maximum value, with IPR demand capped at 75 MGD. The DPR demands are 75 MGD median and 100 MGD seasonal maximum. The following sub-options are developed to evaluate the DPR and IPR treatment train configurations at the AWPF. A partial two-pass RO system is required to reduce nitrate levels to 0.9 mg/L and boron levels to 0.57 mg/L in the advanced treated water.
  - Scenario 4A-HIGH-Single Default Train – A single default treatment train would be constructed at the AWPF, and a single pipeline would serve both DPR (at SLF for the Central Pool) and IPR demands.
  - Scenario 4A-HIGH-Alternative Train – Following IPR treatment train at AWPF, an alternative DPR train would be installed downstream of the IPR train at AWPF to treat the DPR demands only. Separate pipelines would be dedicated to DPR and IPR demands.
- Scenario 4B-LOW-Alternative Train – IPR demands are maximized and met. The DPR demands are 35 MGD median and 50 MGD seasonal maximum. Treatment and pipeline configurations include an IPR train followed by an alternative DPR train at AWPF with dual pipelines for IPR and DPR demands. A partial two-pass RO system is required to reduce nitrate levels to 0.9 mg/L and boron levels to 0.57 mg/L in the advanced treated water that will be introduced directly into SLF.
- Scenario 4C-MED-Alternative Train – An optimized scenario was developed to limit IPR demands to 105 MGD, resulting in a DPR demand of45 MGD median and 60 MGD seasonal maximum. Treatment and pipeline configurations are the same as Scenario 4B-LOW-Alternative Train (i.e., IPR train followed by alternative DPR train at AWPF with dual pipelines to serve IPR and DPR

demands). A partial two-pass RO system is required to reduce nitrate levels to 0.9 mg/L and boron levels to 0.57 mg/L in the advanced treated water that will be introduced directly into SLF.

Figure 5-11 and **Figure 5-12** illustrate the two Scenario 4A sub options, **Figure 5-13** illustrates Scenario 4B, and **Figure 5-14** illustrates Scenario 4C.

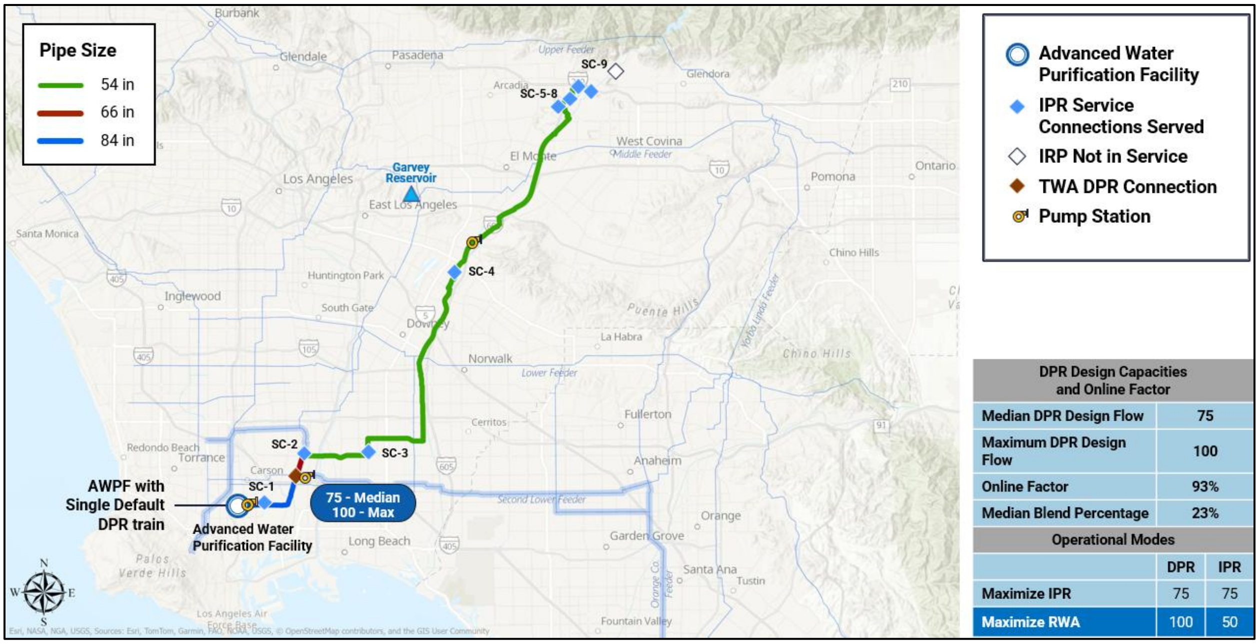


Figure 5-11: Scenario 4A–Single Default DPR Train at AWPF (100 MGD 4A-HIGH)

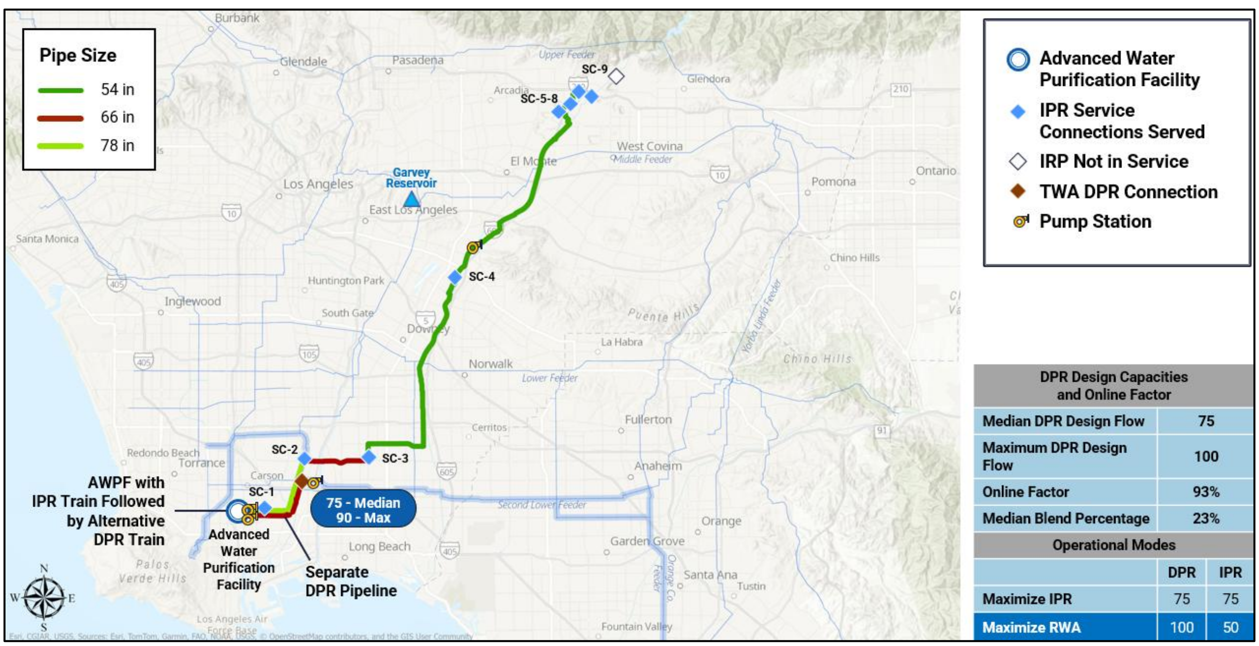


Figure 5-12: Scenario 4A–Alternative DPR Train at AWPF (100 MGD 4A-HIGH)

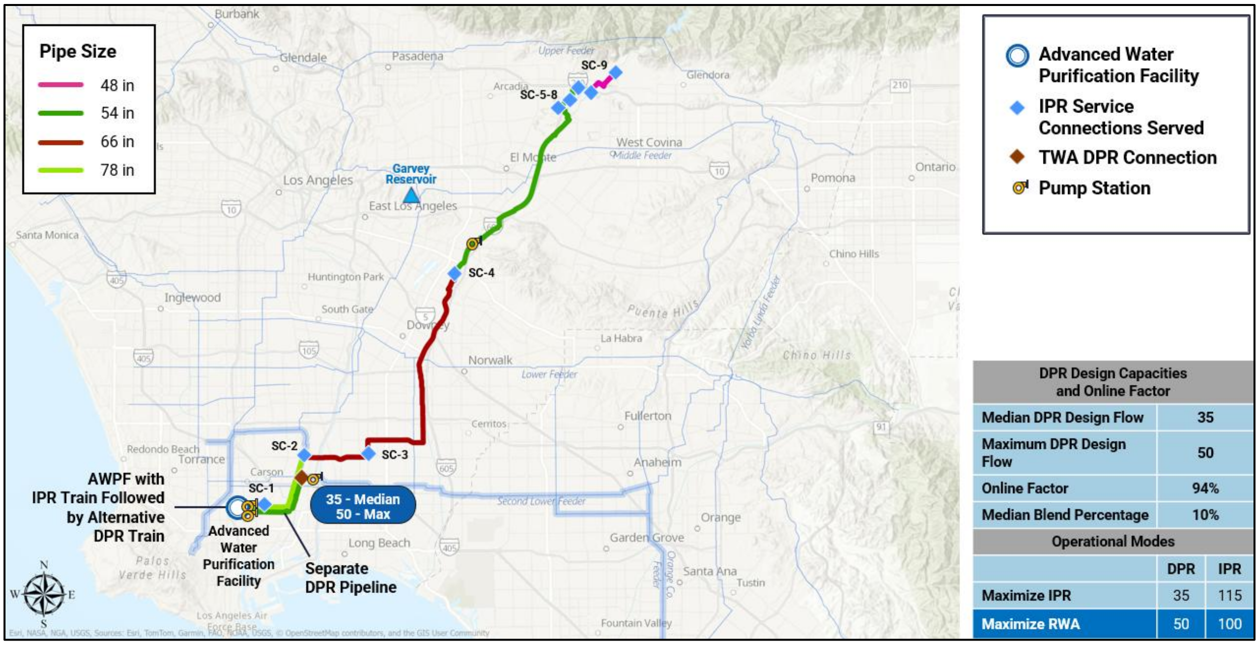


Figure 5-13: Scenario 4B–Alternative DPR Train at AWPF (50 MGD 4B-LOW)

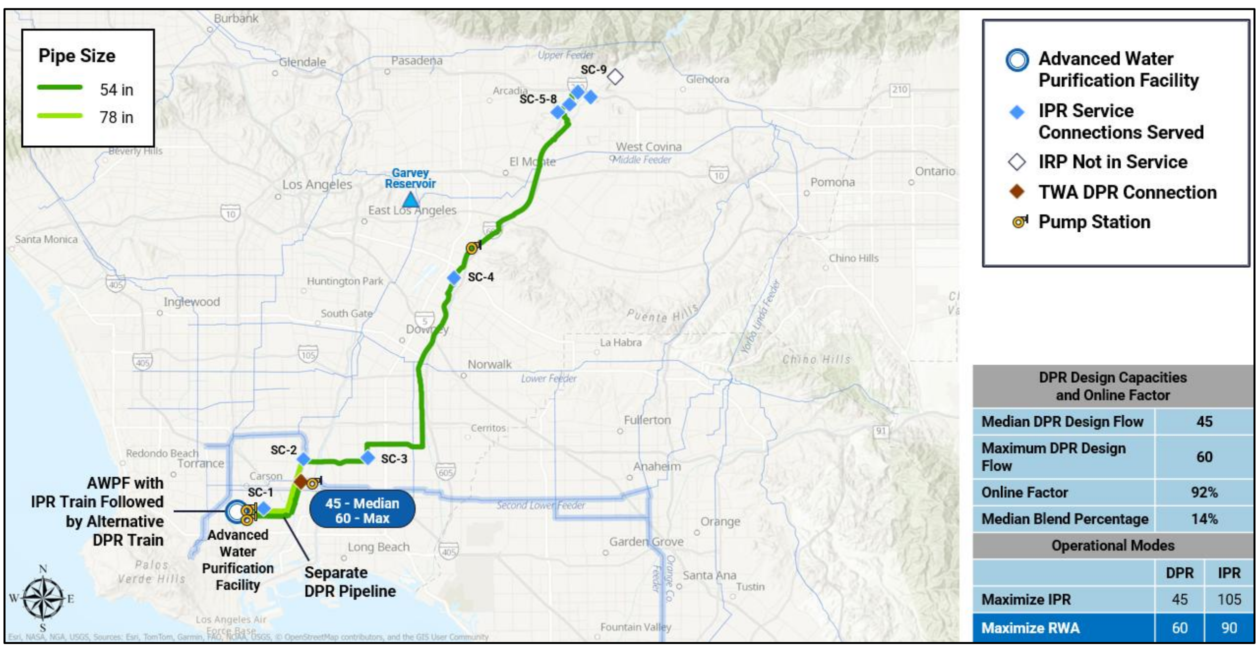


Figure 5-14: Scenario 4C–Alternative DPR Train at AWPF (60 MGD 4C-MED)

Section 6: Evaluation of DPR Implementation Scenarios

Table summarizes the DPR implementation scenarios evaluated for PWSC and discussed throughout this TM. Each scenario is outlined with key attributes that inform its feasibility and integration potential within the broader water reuse strategy. The table includes the following infrastructure needs for each scenario:

- **Treatment Process Requirements:** Summarizes the type and complexity of advanced treatment processes necessary to meet regulatory and water quality standards.
- **Conveyance Attributes:** Describes the infrastructure needs for conveying water to and from treatment facilities and end-use points.

In addition to the infrastructure needs, Table also highlights the following:

- **Implementation Challenges:** Preliminary identification of potential challenges such as O&M for treatment facilities and existing feeders, hydraulic/water quality concerns, and IPR demands. In addition, identifying an available vacant parcel that is suitable for locating a satellite DPR treatment facility will present additional challenges.
- **Opportunities and Synergies:** Strategic advantages such as co-location with the existing facilities, shared infrastructure, or alignment with other planned capital projects that could reduce overall costs and enhance long-term operational efficiency and flexibility, and opportunities to expand the system in the future to reduce capital and O&M costs.

It is important to note that while challenges have been identified at a high level, they have not been fully explored in this TM. If a particular scenario emerges as a preferred option, these challenges can be addressed in greater detail through future targeted studies and technical evaluations. Finally, the identification of opportunities and synergies plays a critical role in long-term planning. Leveraging these factors can lead to significant capital and operational cost savings, making them essential considerations in the decision-making process.

Factors such as system reliability, regulatory and operational complexity, water quality impacts, and space availability for the satellite DPR treatment facility, play a key role in decision-making. Potential non-financial criteria, along with preliminary inputs under each criterion, are presented in Table 6-2. Considering these factors alongside cost provides a comprehensive assessment of system reliability, regulatory confidence, and public acceptance, while minimizing impacts on Metropolitan's existing system.

Table 6-1: DPR Implementation Scenario Assessment

Scenario	Identifier	Infrastructure Needs	Implementation Challenges	Opportunities and Synergies to maximize the online factor and reduce PWSC cost
1A	1A-LOW-WEY-IPR TRAIN & ALT DPR-2N	• IPR facility at AWPF • Full extent of Backbone Pipeline (39.1 miles) • Improvements related to the Azusa pipeline, additional PSs • New DPR Pipeline & pump station • RWA satellite facility at Weymouth	• Finding suitable locations for multiple advanced water treatment (AWT) locations (AWPF and Satellite) • Backbone and DPR pipelines with multiple pump stations • Requires a partial second pass RO and blending to meet the nitrate (2 mg/L) and boron (0.57 mg/L) targets • Requires rehabilitation of the existing Azusa Pipeline	• Repurposing the existing Azusa pipeline • Leveraging Weymouth and Diemer plant infrastructure and operations • Additional treatment and water quality control before distribution
1B	1B-LOW-WEY-IPR TRAIN & ALT DPR-2N	• IPR facility at AWPF • Full extent of Backbone Pipeline (39.1 miles) • New DPR Pipeline • RWA satellite facility at Weymouth	• Similar to challenges listed in Scenario 1-A, except for Azusa Pipeline rehabilitation	• Leveraging Weymouth and Diemer plant infrastructure and operations • Additional treatment and water quality control before distribution • Use the Azusa pipeline as a backup to the DPR pipeline, provided the pipeline is extended to Canyon Spreading Grounds (cost and online factor impacts from using the Azusa pipeline are not considered at this time)
1C	1C-LOW-WEY-IPR TRAIN & ALT DPR-0.9N	• IPR facility at AWPF • Full extent of Backbone Pipeline (39.1 miles) • Improvements related to the Azusa pipeline, additional PSs • RWA satellite facility at Weymouth • TWA satellite facility near MF	• Similar to challenges listed in Scenario 1-A, with addition of finding TWA satellite location	• Similar to opportunities and synergies listed in Scenario 1-A and Scenario 2
2	2-LOW-WEY RSVR-IPR TRAIN & ALT DPR-0.9N	• IPR facility at AWPF • Full extent of Backbone Pipeline (39.1 miles) • New DPR Pipeline • TWA Satellite facility at Weymouth	• Finding suitable locations for multiple AWT locations (AWPF and Satellite) and multiple pipelines • Requires a partial second pass RO and blending to meet the nitrate (2 mg/L) and boron (0.57 mg/L) targets • Requires rehabilitation of the existing Azusa Pipeline	• Leveraging the robust water distribution from the Weymouth Finished Water Reservoir • Use the Azusa pipeline as a backup to the DPR pipeline, provided the pipeline is extended to Canyon Spreading Grounds (cost and online factor impacts from using the Azusa pipeline are not considered at this time)
3A-MF	3A-HIGH-MF-IPR TRAIN & ALT DPR-0.9N	• IPR facility at AWPF • Backbone Pipeline • TWA satellite facility near MF	• Finding suitable locations for multiple AWT locations (AWPF and Satellite) • Nitrification, water age management, and maintaining ideal water quality • Requires a second pass RO for meeting the nitrate (0.9 mg/L) and boron (0.57 mg/L) targets • Challenges associated with water supply management for existing feeders and member agencies • IPR demands are limited to 75 MGD • Connection for DPR is further away from AWPF, resulting in a larger backbone pipeline	• Opportunity to use Garvey Reservoir for storage • Reduced backbone pipeline (size and extent of pipeline, no Canyon (SC-9) connection) • Eliminating the pipeline to Weymouth
3A-SLF	3A-HIGH-SLF-IPR TRAIN & ALT DPR-0.9N	• IPR facility at AWPF • Backbone Pipeline • TWA satellite facility near SLF	• Similar to challenges in Scenario 3A HIGH-MF, except for a larger backbone pipeline needed for MF	• Similar to opportunities and synergies listed in Scenario 3A HIGH-MF, except for the use of Garvey Reservoir for storage
3B-0.9	3B-LOW-SLF-IPR TRAIN & ALT DPR-0.9N	• IPR facility at AWPF • Full extent of Backbone Pipeline (39.1 miles) • TWA satellite facility near SLF	• Requires a pipeline to Canyon Spreading Grounds • Similar to challenges listed in Scenario 3A HIGH-SLF, except for limitation in IPR demand	• IPR demands are met • Similar to opportunities and synergies listed in Scenario 3A HIGH-SLF

Scenario	Identifier	Infrastructure Needs	Implementation Challenges	Opportunities and Synergies to maximize the online factor and reduce PWSC cost
3B-2	3B-LOW-SLF-IPR TRAIN & ALT DPR-2N	• IPR facility at AWPF4 • Full extent of Backbone Pipeline (39.1 miles) • TWA satellite facility near SLF	• Requires a pipeline to Canyon Spreading Grounds • Similar to challenges listed in Scenario 3A HIGH-SLF, except for limitation in IPR demand, and RO requirement at the Satellite Facility	• IPR demands are met • Similar to opportunities and synergies listed in Scenario 3A HIGH-SLF
3C	3C-MED-SLF-IPR TRAIN & ALT DPR-0.9N	• IPR facility at AWPF • Backbone Pipeline • TWA satellite facility near SLF	• IPR demands are limited to 105 MGD • Similar to challenges listed in Scenario 3A HIGH-SLF	• Both IPR and DPR demands are optimized (IPR demands are limited to 105 MGD) • Similar to opportunities and synergies listed in Scenario 3A HIGH-SLF
4A-Single Default	4A-HIGH-SLF-SINGLE PIPE-SINGLE DFLT DPR TRAIN-0.9N	• Default DPR train at AWPF • Single backbone DPR pipeline	• IPR demands are limited to 75 MGD • Challenge of maintaining ideal water quality for IPR and DPR in one conveyance system • Additional treatment for IPR beyond the required barriers • Requires a second pass RO for meeting the nitrate (0.9 mg/L) and boron (0.57 mg/L) targets • Nitrification, water age management, and maintaining ideal water quality • Challenges associated with water supply management for existing feeders and member agencies	• Single AWT at AWPF resulting in consolidated operations • Reduced backbone pipeline (size and extent of pipeline, no Canyon (SC-9) connection) • Eliminating the pipeline to Weymouth
4A-Alternative	4A-HIGH-SLF-DUAL PIPE-IPR TRAIN & ALT DPR-0.9N	• IPR train and Alternative DPR train at AWPF • Backbone Pipeline • DPR pipeline from AWPF to SLF	• Multiple treatment trains • Nitrification, water age management, and maintaining ideal water quality • Requires a second pass RO for meeting the nitrate (0.9 mg/L) and boron (0.57 mg/L) targets • Challenges to co-locate Backbone and DPR pipelines in congested rights-of-way, less favorable separate corridors are anticipated	• Similar to opportunities and synergies listed in Scenario 4A-Single Default, except for single AWT and single pipeline
4B-Alterantive	4B-LOW-SLF-DUAL PIPE-IPR TRAIN & ALT DPR-0.9N	• IPR train and Alternative DPR train at AWPF • Full extent of Backbone Pipeline (39.1 miles) • DPR pipeline from AWPF to SLF	• Requires a pipeline to Canyon Spreading Grounds • Similar to challenges listed in Scenario 4A-Alternative	• IPR demands are met • Similar to opportunities and synergies listed in Scenario 4A-Alternative, except for elimination of pipeline to Canyon
4C-Alternative	4C-MED-SLF-DUAL PIPE-IPR TRAIN & ALT DPR-0.9N	• IPR train and Alternative DPR train at AWPF • Backbone Pipeline • DPR pipeline from AWPF to SLF	• IPR demands are limited to 105 MGD • Similar to challenges listed in Scenario 4A- Alternative	• Both IPR and DPR demands are optimized (IPR demands are limited to 105 MGD) • Similar to opportunities and synergies listed in Scenario 4A-Alternative

[1] To augment raw water supplies at Weymouth and/or Diemer [2] With storage in Garvey Reservoir (via Middle Feeder)

Table 6-2: Potential DPR Implementation Scenario Evaluation Non-Financial Criteria and Preliminary Inputs

	RWA at Weymouth	TWA at Weymouth	TWA at Central Pool via DPR Treatment at Satellite Facility		TWA at Central Pool via DPR Treatment at AWPF	
	Scenario 1	Scenario 2	3A-HIGH-SLF 3B-LOW-SLF 3C-MED-SLF	3A-HIGH-MF	4A-HIGH-Single Default Train	4A-HIGH-Alternative-Dual 4B-LOW-Alternative-Dual 4C-MED-Alternative-Dual
Category	RWA Connection Near Weymouth Raw Water Junction Structure	TWA Connection at Weymouth Finished Water Reservoir and MF	TWA connection at SLF	TWA connection at MF	TWA connection at SLF via Single IPR-DPR Pipeline	TWA connection at SLF via Dedicated DPR Pipeline
Multi Barrier Treatment	• IPR Train + Ozone/GAC/UV	• IPR Train + Alternative DPR Train (Ozone/GAC/MF) + Nitrate Treatment (2nd Pass RO)	• IPR Train + Alternative DPR Train (Ozone/GAC/MF) + Nitrate Treatment (2nd Pass RO)	• IPR Train + Alternative DPR Train (Ozone/GAC/MF) + Nitrate Treatment (2nd Pass RO)	• Default DPR Train (Ozone/BAC/MF/RO/UV-AOP) + Nitrate/Boron Treatment (2nd Pass RO)	• IPR Train + Alternative DPR Train (Ozone/GAC/MF) + Nitrate Treatment (2nd Pass RO)
Regulatory Acceptance (DPR Permitting)	• Requires equivalency demonstration and regulatory approval of the Alternative DPR train.				• Favorable permitting is anticipated with the Default DPR Train, based on similar projects pursuing the Default-train TWA.	• Requires equivalency demonstration and regulatory approval of the Alternative DPR train.
Schedule	• This scenario is incorporated into the baseline PWSC Schedule.	• Additional timeline required for equivalency demonstration and Alternative train approval. • Additional time associated with site development and construction of the satellite treatment facility.	• Additional timeline required for equivalency demonstration and Alternative train approval. • Additional time associated with site development and construction of the satellite treatment facility (land acquisition and associated permits).		• Leveraging a single AWPF treatment site is expected to streamline implementation, with favorable DPR permitting anticipated for the default train.	• Additional timeline required for equivalency demonstration and Alternative train approval. • Construction of the DPR pipeline from AWPF to the SLF will be challenging and may require separate, less favorable corridor.
Water Quality Impacts	• Weymouth operations will be optimized to accommodate purified water as a raw water source, which is expected to mitigate potential water quality impacts associated with RWA.	• Introducing purified water at the Weymouth FWR could enhance the ability to manage nitrate and other water quality parameters in the advanced treated water.	• The effects on nitrate and other water quality parameters resulting from the introduction of advanced treated water at the SLF require evaluation and verification.			
Hydraulic Integration	• Fully integrated with the raw water supply management	• The introduction of TWA at Weymouth allows the new source to be effectively integrated with the existing distribution system.	• Potential demand-management challenges and water-age issues in specific sections of the feeder during low-demand periods require evaluation and verification.			
Operational Complexity/ Staffing	• A standalone treatment facility for the RWA treatment train in addition to the IPR train at AWPF • Integration of a new raw water source into an existing plant	• A standalone alternative DPR satellite treatment facility in addition to the IPR train at AWPF	• A standalone alternative DPR satellite treatment facility in addition to the IPR train at AWPF • Additional operational complexity due dechlorination		• AWPF with a single default DPR train serving both DPR and IPR demands. Lowest operational complexity compared to other scenarios	• Potentially favorable operations with the alternative DPR train located within the AWPF
Nitrification Challenges in Feeders	• With RWA, the nitrification challenges are expected to remain unchanged	• With the introduction of TWA quality water at Weymouth, the nitrification challenges are expected to remain unchanged.	• Potential nitrification challenges in the SLF between the Diemer plant and the TWA connection will need to be assessed.	• Potential additional nitrification challenges in the MF between the Weymouth plant and the TWA connection will need to be assessed.	• Potential additional nitrification challenges in the SLF between the Diemer plant and the TWA connection will need to be assessed.	
Residuals and Off-spec Flow Management	• Residuals handling and off-spec flow management may present challenges near the Weymouth plant because of the limited available sewer capacity.		• Potential satellite treatment site near the SLF may have limited capacity to handle residuals and off-spec flows.	• Available sewer capacity to receive residuals and off-spec flows from the Satellite Facility, to be located near the MF, needs to be verified.	• Locating both DPR and IPR treatment within the AWPF provides the most favorable conditions.	
Monitoring and Automation Intensity/Response Time to Upsets	• RWA provides a longer response time through integration with existing drinking water treatment processes	• The Weymouth finished water reservoir provides limited storage for managing process upsets • TWA relies more heavily on continuous advanced treatment performance, requires more stringent monitoring and control, and has higher consequences associated with treatment upsets	• TWA relies more heavily on continuous advanced treatment performance, requires more stringent monitoring and control, and has higher consequences associated with treatment upsets	• Garvey Reservoir, located downstream of the Middle Feeder connection, provides downstream storage buffering. • TWA relies more heavily on continuous advanced treatment performance, requires more stringent monitoring and control, and has higher consequences associated with treatment upsets	• TWA relies more heavily on continuous advanced treatment performance, requires more stringent monitoring and control, and has higher consequences associated with treatment upsets	
Public Acceptance	• RWA, through the introduction of purified water upstream of the Weymouth plant, could enhance public acceptance.	• TWA implementation will require enhanced public engagement efforts, leveraging the DPR demonstration facility that is currently being designed and constructed.				

Section 7: DPR Implementation Costs

This section describes the methodology and basis used to prepare rough-order-of magnitude (ROM) estimates for each DPR implementation scenario, including key components considered for the estimates.

7.1 Basis of Cost Analysis

The key components that form the basis of cost analysis for each DPR Implementation scenario include:

- **DPR Treatment Process Train**: Specifies the type of advanced water treatment required, distinguishing between default and alternative DPR treatment trains.
- **Location and Facility Type**: Identifies the geographic location and classification of facilities (e.g., AWPF versus satellite).
- **Advanced Water Treatment (AWT) Processes**: Provides details of the specific unit processes assumed for each scenario. The default DPR train was used for most of the DPR treatment scenarios at the AWPF. For satellite treatment options, it was necessary to assume a potential alternative DPR train. The ongoing design and expansion of the demonstration facility will test multiple alternative DPR treatment trains.
  - **IPR Treatment**: MBR (not included in cost analysis), RO, two-pass RO, UV/AOP, post-stabilization and chlorination
  - **RWA Satellite Treatment**: Ozone, granular activated carbon (GAC), and UV disinfection
  - **TWA Satellite Treatment (all TWA scenarios except for Scenario 4A-Default)**: Ozone, GAC, MF, RO (mainly for nitrate removal), post-stabilization, and chlorination
  - **ATW Conditioning (for Scenario 4A-Default):** Post-stabilization and chlorination
- **Storage, Pumping, and Hydraulic Controls**: Provides storage/buffer for advanced treated water and sufficient pressure for the introduction of advanced treated water into Metropolitan feeders. These components include provisions for pressure regulating valve turnout stations and flowmeters as potential hydraulic control elements.
- **Capacity**: Reflects the maximum and median flow rates and sizing requirements for each treatment facility. Treatment costs were based on median flow values and a peaking factor to account for seasonal maximum DPR demands.
  - **Conveyance Needs**: Includes pipeline infrastructure required to convey water between facilities and distribution points. Conveyance sizing was estimated based on pipeline diameter metrics, with hydraulic design parameters assuming the following: Velocity not exceeding 6 feet per second (fps) for pressurized pipelines. For HIGH scenarios under Scenarios 3 and 4, velocities are allowed to reach up to, but not exceed, 6.5 fps.
  - Conveyance estimates were based on the conceptual alignment of the backbone pipeline and anticipated means of construction for Reaches 1 through 8. Construction methods generally included open-cut, micro-tunneling, and/or tunneling. These factors were extracted from the Pure Water Conveyance Facilities Conceptual Design Report submitted to Metropolitan (Black & Veatch, 2025) and generalized for the purpose of this DPR analysis.

This structured approach enables consistent cost estimation across scenarios and highlights the technical and logistical considerations that influence implementation. The assumptions made, particularly regarding treatment train configurations and conveyance design, reflect current planning constraints and available data.

7.2 Rough-Order-of-Magnitude Estimates

Rough-order-of magnitude (ROM) estimates were prepared for each DPR implementation scenario, consistent with early-stage conceptual planning. According to industry standards, ROM estimates typically carry an accuracy range of –50% to +100%, reflecting the limited design definition and reliance on broad assumptions. The following sections summarize the methodology employed for these estimates. Cost estimates were developed for comparative purposes only and should not be used to represent total project estimates for any scenario.

7.2.1 Baseline Scenario

The baseline cost was established through the 2025 PWSC Program cost update effort, presented at the Board Workshop on September 23, 2025. The estimates were developed based on the design maturity level of each PWSC asset (AWT, Conveyance System, and Recharge Facilities). The conceptual design efforts to date for each asset resulted in setting the AWT's maturity level between 10 and 12 percent and the conveyance system's maturity level between 5 and 10 percent. This resulted in a 30 percent contingency used for the AWT, and Conveyance Reaches 1 and 2, and a 35 percent contingency for Conveyance Reaches 3 through 8.

Major cost components of the updated PWSC costs (PWSC Cost Estimate TM, February 2026) are summarized in Table 7-1.

Table 7-1: PWSC Baseline Budget–Major Cost Components

Asset	Major Cost Component
AWPF	• Site Preparation • Process Equipment • Chemical Feed Systems • Power/Electrical Facilities • SCE Substation • Ancillary Facilities • Outreach Facilities • Workforce Training Center • DPR Facilities
Conveyance and Recharge Facilities	Conveyance Facilities • Pipelines (backbone, DPR) • Service Connections and Laterals • Pump Stations • SCE Substation • Azusa Pipeline Rehabilitation • Property Easements and Acquisitions Recharge Facilities • Spreading Facility Improvements • Well Relocations and Groundwater Monitoring • Acquisition of a Spreading Facility
Other Costs	• Environmental Mitigation • Community Benefits • Buy America Build America Act (BABAA) and Tariff Allowances • Management/engineering • Contingencies • AWPF Permitting

Key assumptions used to develop the 2025 PWSC Baseline Budget are listed in the 2026 PWSC Cost Estimate TM and include escalation rates for capital and O&M costs, contingency values, and allowances for BABAA and non-allocatable tariffs.

For the purposes of this analysis, the baseline cost included Metropolitan's share of costs only and excluded Los Angeles County Sanitation Districts share of costs for pretreatment facilities (e.g., Membrane Bioreactor). The primary impact of DPR implementation on the MBR system is associated with nitrate concentrations in the effluent. For all DPR scenarios, the MBR effluent nitrate concentration is anticipated to be 19 mg/L as nitrogen (N). Incremental lifecycle costs necessary to achieve the target nitrate levels for RWA and TWA are included in the respective scenario cost estimates.

Scenario 1A, RWA at the Weymouth plant, represents the DPR baseline scenario. Its cost was adjusted for a different satellite treatment train and other infrastructure requirements needed to implement RWA (greater than 10% DPR blend) at Weymouth.

7.2.2 Development of ROM Costs for Other DPR Scenarios

To compare the different DPR scenarios, Scenario 1A cost was adjusted based on cost factors presented in Section 7.1, such as the anticipated treatment trains, treatment design capacity, and sizing of the conveyance pipeline and pump station(s).

- Cost estimates of the satellite DPR treatment facility for Scenarios 3 and 4 were derived using median plant-size and capacity adjustment factors based on a power-law equation.
- Unit costs for the conveyance pipeline varying in diameter were estimated based on the values included in the Pure Water Conceptual Design Report (Black & Veatch, 2025) baseline costs for the 84-inch backbone pipeline (calculated unit cost values for 84-in pipeline ranged from $125 $/LF-in to $219 $/LF-in). Backbone pipeline sizing was adjusted based on anticipated IPR and DPR design capacities, while accommodating sufficient pipeline capacity needed to meet IPR demands at Main San Gabriel Basin.

7.2.3 Development of O&M and Lifecycle Costs

Operation and Maintenance (O&M) costs were also included in the 2025 PWSC Program Cost Update for treatment, conveyance, and recharge facilities, and included Metropolitan labor, major equipment repair or replacement, chemicals, energy, and other consumables. Historical data and previous engineering estimates were used to estimate treatment and conveyance facilities O&M costs. Recharge facilities O&M costs were estimated based on experience with similar projects in the region (PWSC Cost Estimate TM, February 2025). These recent estimates were also used for this analysis.

Lifecycle costs ($/AF) were estimated based on 150 MGD total capacity.

7.2.4 Comparative ROM Costs for DPR Implementation Scenarios

Table presents a comparative summary of the potential DPR implementation scenarios, including ROM estimates for both capital, O&M, and lifecycle costs. These estimates provide a high-level financial framework to support scenario screening and planning decisions. As the PWSC advances, these elements will be refined through future technical studies and design development. Based on the preliminary estimates, Scenario 4A (using default DPR treatment train at the AWPF with a single pipeline) could potentially provide the most cost savings for DPR implementation.

The following items are identified for further investigations and are therefore not included in the ROM cost estimates:

- Specific mitigation measures for addressing potential nitrification challenges in the feeders
- Management of concentrate from two-pass RO
- Required pipe length to connect satellite facility with the feeder, as the satellite facility sites have not been finalized.
- Management of off-spec and treatment residuals from the satellite facilities. Evaluation of sewer capacity will also be required to assess the discharge of waste streams from the satellite DPR treatment facilities.
- Property acquisition and easement costs of satellite and pumping facilities to integrate DPR into existing feeders
- Feasibility of separate/dual Backbone and DPR pipelines within the same corridor and the associated cost impact for Scenarios 4A, 4B and 4C should an additional corridor/alignment be required.

Attachment A lists additional ROM cost assumptions, unit cost calculations, and scaling basis for treatment facilities and conveyance infrastructure.

Table 7-2: Comparative Costs for DPR Implementation Scenarios[1]

Scenario	Identifier	DPR Capacity, MGD	DPR Treatment Location	DPR Treatment Processes	Pipelines	ROM Capital Cost ($M)	Relative Capital Cost Percentage Difference (%)	Annual O&M Cost ($M)	Relative O&M Percentage Difference (%)	Online Factor	$/AF (Considering Online Factor)	Relative Unit Percentage Difference (%)[1]
1A	1A-LOW-WEY-IPR TRAIN & ALT DPR-2N	60 (Max) 30 (Median)	RWA Alternative Satellite	Ozone, GAC, UV	Backbone IPR Azusa Pipeline DPR Pipeline	$10,100	Baseline	$310	Baseline	95%	$5,560	Baseline
1B	1B-LOW-WEY-IPR TRAIN & ALT DPR-2N	60 (Max) 40 (Median)	RWA Alternative Satellite	Ozone, GAC, UV	Backbone IPR DPR Pipeline	$9,700	-4%	$300	-3%	92%	$5,530	-1%
1C	1C-LOW-WEY-IPR TRAIN & ALT DPR-0.9N	60 (Max) 30 (Median)	RWA Alternative Satellite	Ozone, GAC, UV	Backbone IPR Azusa Pipeline DPR Pipeline	$10,500	4%	$300	-3%	100%	$5,360	-4%
2	2-LOW-WEY RSVR-IPR TRAIN & ALT DPR-2N	60 (Max) 40 (Median)	TWA Alternative Satellite	Ozone, GAC, MF, Chlorine	Backbone IPR DPR Pipeline	$10,400	3%	$330	6%	92%	$5,990	8%
3A-MF	3A-HIGH-MF-IPR TRAIN & ALT DPR-0.9N	100 (Max) 75 (Median)	TWA Alternative Satellite	Ozone, GAC, MF, Chlorine	Backbone IPR DPR Pipeline	$10,000	-1%	$340	10%	93%	$5,840	5%
3A-SLF	3A-HIGH-SLF-IPR TRAIN & ALT DPR-0.9N	100 (Max) 75 (Median)	TWA Alternative Satellite	Ozone, GAC, MF, Chlorine	Backbone IPR DPR Pipeline	$8,900	-12%	$330	6%	93%	$5,380	-3%
3B-0.9N	3B-LOW-SLF-IPR TRAIN & ALT DPR-0.9N	50 (Max) 35 (Median)	TWA Alternative Satellite	Ozone, GAC, MF, Chlorine	Backbone IPR DPR Pipeline	$8,700	-14%	$300	-3%	94%	$5,050	-9%
3B-2N	3B-LOW-SLF-IPR TRAIN & ALT DPR-2N	50 (Max) 35 (Median)	TWA Alternative Satellite	Ozone, GAC, MF, Chlorine	Backbone IPR DPR Pipeline	$8,700	-14%	$280	-10%	94%	$4,940	-11%
3C	3C-MED-SLF-IPR TRAIN & ALT DPR-0.9N	60 (Max) 45 (Median)	TWA Alternative Satellite	Ozone, GAC, MF, Chlorine	Backbone IPR DPR Pipeline	$8,700	-14%	$300	-3%	92%	$5,170	-7%
4A-Default DPR	4A-HIGH-SLF-SINGLE PIPE-SINGLE DFLT DPR TRAIN-0.9N	100 (Max) 75 (Median)	TWA Default AWPF	Ozone, BAC, MF, RO, UV/AOP	Single DPR pipeline from AWPF serving DPR and IPR demands	$8,800	-13%	$280	-10%	93%	$4,990	-10%
4A-Alternative DPR	4A-HIGH-SLF-DUAL PIPE-IPR & ALT DPR TRAINS-0.9N	100 (Max) 75 (Median)	TWA Alterative AWPF	Ozone, GAC, MF, Chlorine	Separate DPR and IPR Pipelines from AWPF	$9,600	-5%	$330	6%	93%	$5,620	1%
4B	4B-LOW-SLF-DUAL PIPE-IPR TRAIN & ALT DPR-0.9N	50 (Max) 35 (Median)	TWA Alterative AWPF	Ozone, GAC, MF, Chlorine	Separate DPR and IPR Pipelines from AWPF	$9,400	-7%	$300	-3%	94%	$5,290	-5%
4C	4C-MED-SLF-DUAL PIPE-IPR TRAIN & ALT DPR-0.9N	60 (Max) 45 (Median)	TWA Alterative AWPF	Ozone, GAC, MF, Chlorine	Separate DPR and IPR Pipelines from AWPF	$9,000	-11%	$300	-3%	92%	$5,290	-5%

[1] Relative cost value assesses the difference compared to Scenario 1A (PWSC Baseline)

Section 8: Key Findings

The key findings from the assessment of potential DPR implementation strategies are summarized in this section.

8.1 Maximum Attainable DPR via Treated Water Augmentation

PWSC's baseline scenario (Scenario 1A) incorporates DPR via RWA, in which advanced treated water would be introduced upstream of the Weymouth plant and subsequently treated through the conventional drinking water treatment process. In contrast, DPR via TWA, evaluated under Scenarios 2, 3, and 4, would involve introducing advanced treated water directly into Metropolitan's distribution system, either via a feeder connection (e.g. Second Lower Feeder or Middle Feeder) or through the Weymouth FWR.

The maximum achievable TWA would be governed by several key technical and operational constraints, including the blending ratio of advanced treated water with imported water in the feeders (assumed at 50 percent as described in Section 4.2.7), the requirement to maintain sufficient imported water to support downstream water treatment plant operations, and the year-round treated water demands. In addition, the physical capacity of the Metropolitan feeder system would play a critical role in determining the feasible upper bound of DPR implementation.

Based on these constraints, the maximum attainable TWA under Scenarios 3 and 4 is estimated at approximately 75 MGD (median), with a seasonal peak demand of 100MGD. As summarized in Table 8-1, achieving these higher DPR levels would result in a corresponding reduction in the IPR demand, potentially capped at 75 MGD.

Table 8-1: Maximum Attainable DPR via TWA

	Maximum Attainable DPR[1] via TWA under Scenarios 3 and 4
Seasonal Maximum DPR Flow	100 MGD
Median DPR Flow	75 MGD
IPR Flow Cap	75 MGD
IPR Termination Point	Santa Fe Spreading Grounds

[1]Online factor 93% or above; 150 MGD PWSC (Median DPR + IPR Flow); WTP Minimum Sustainable Flows are met; nitrate and boron targets are met

This shift in demand allocation could have important implications for system configuration. With reduced reliance on IPR demands, the PWSC conveyance pipeline could be shortened and terminated at the Santa Fe Spreading Grounds, eliminating the need to extend 1.7 miles to the Canyon Spreading Grounds, which was included in the baseline scenario. This adjustment would support a more streamlined and cost-effective conveyance strategy while aligning with the increased role of TWA in meeting system supply objectives.

Under Scenario 2, TWA through Weymouth FWR, the maximum achievable TWA would be established at 60 MGD. This capacity aligns directly with the RWA demand at the Weymouth plant (i.e. the baseline scenario), providing a consistent benchmark for comparison between the two DPR approaches.

8.2 Potential of Reducing Conveyance Pipeline Size and Length

Under the baseline scenario (Scenario 1A), the backbone pipeline would serve as critical infrastructure, conveying purified water to IPR service connections as well as to the Weymouth plant for RWA. The 84-inch-diameter backbone pipeline was sized to convey up to 150 MGD, which would result in substantial conveyance-related capital and life-cycle costs. Implementation of TWA at the Central Pool (Scenarios 3 and 4) would redirect a significant portion of purified water for satellite DPR treatment before introducing the water directly into Metropolitan feeders (Second Lower Feeder or Middle Feeder). Reducing the IPR demand and/or replacing the RWA demand with TWA demand would allow elimination of the need for the Weymouth connection, which would enable potential downsizing of the backbone pipeline. Terminating the IPR connection at the Santa Fe Spreading Grounds (instead of Canyon Spreading Grounds as in the DPR baseline) would shorten the overall pipeline length (i.e. 1.7 miles of 48-inch diameter pipeline). In addition, removing the Weymouth connection would eliminate the associated DPR pipeline (i.e. 12 miles of 54-inch pipeline). The resulting conveyance pipeline size and length reductions relative to the baseline are summarized in Table 8-2 below.

Table 8-2: Potential Reduction in Conveyance Pipeline Size and Length [1]

<table>
<tr><th></th><th colspan="2">Scenario 1: RWA at Weymouth via Satellite Facility (Baseline)</th><th colspan="2">Scenario 3: TWA at Central Pool via Satellite Facility</th><th colspan="2">Scenario 4: TWA at Central Pool via AWPF</th></tr>
<tr><td>Seasonal Maximum DPR Flow</td><td colspan="2">60 MGD</td><td colspan="2">100 MGD</td><td colspan="2">100 MGD</td></tr>
<tr><td>Median DPR Flow</td><td colspan="2">45 MGD</td><td colspan="2">75 MGD</td><td colspan="2">75 MGD</td></tr>
<tr><td>IPR Flow Cap</td><td colspan="2">105 MGD</td><td colspan="2">75 MGD</td><td colspan="2">75 MGD</td></tr>
<tr><td rowspan="3">Backbone pipeline (size and length)</td><td>84”</td><td>37.4 mi</td><td>90”</td><td>4.3 mi</td><td>84”</td><td>4.3 mi</td></tr>
<tr><td rowspan="2">48”</td><td rowspan="2">1.7 mi</td><td>66”</td><td>1.6 mi</td><td>66”</td><td>1.6 mi</td></tr>
<tr><td>54”</td><td>31.5 mi</td><td>54”</td><td>31.5 mi</td></tr>
<tr><td>DPR Connection Point</td><td colspan="2">Weymouth Raw Water Junction Structure</td><td colspan="4">Second Lower Feeder</td></tr>
<tr><td>IPR Termination Point</td><td colspan="2">Canyon Spreading Grounds</td><td colspan="4">Santa Fe Spreading Grounds</td></tr>
<tr><td>DPR Pipeline (size and length)</td><td>54”</td><td>12 mi</td><td colspan="4">DPR Pipeline is Eliminated</td></tr>
<tr><td>Baseline/Relative Capital Cost</td><td colspan="2">$10.1B</td><td colspan="2">-12%</td><td colspan="2">-13%</td></tr>
<tr><td>Baseline/Relative O&M Cost</td><td colspan="2">$310M</td><td colspan="2">+6%</td><td colspan="2">-10%</td></tr>
<tr><td>Baseline/Relative Unit Cost</td><td colspan="2">$5,560/AF</td><td colspan="2">-3%</td><td colspan="2">-10%</td></tr>
</table>

Notes: (1) AF = acre-feet; B = billion; DPR = direct potable reuse; IPR = indirect potable reuse; M = million; mi = miles; Relative cost value assesses the difference compared to Scenario 1A (PWSC Baseline).

As shown in Table 8-2, Scenario 3 would utilize SLF for TWA with a satellite facility to treat purified water to DPR standards. To accommodate additional feed flow for the satellite facility, the backbone pipeline would be upsized to 90 inches in diameter over a 4.3-mile segment. The downstream backbone pipeline could be downsized to 66 inches in diameter over a 1.6-mile segment, then to 54 inches for 31.5 miles. The dedicated DPR pipeline to Weymouth would be eliminated. These modifications would reduce PWSC capital costs by approximately $1.20 billion, inclusive of the satellite facility; however, additional advanced treatment processes at multiple locations (i.e., AWPF and satellite facility) would result in higher annual O&M costs.

Under Scenario 4, SLF would also be utilized for TWA, but treatment for DPR would take place at the AWPF. The length of the 84-inch-diameter backbone pipeline would be reduced from 37.4 miles (baseline) to 4.3 miles, with most of the remaining pipe sized for 54 inches in diameter. Similar to Scenario 3, the Weymouth connection would be eliminated, yielding significant capital cost savings. Furthermore, centralizing treatment at the AWPF would provide notable reductions in annual O&M and overall life-cycle costs.

8.3 Balancing DPR and IPR Demands for Operational Flexibility

Maximizing TWA at the Central Pool (Scenarios 3 and 4) would substantially reduce reliance on IPR, by shifting a greater portion of supply to purified water delivered through the Metropolitan feeders. Under the maximum DPR scenario, maintaining TWA at 75 MGD (median) up to 100 MGD (during seasonal peak conditions) could limit the IPR demand to 75 MGD. To provide flexibility in system operations and maintain a total PWSC system capacity of 150 MGD, alternative demand balancing scenarios between DPR and IPR are summarized in Table 8-3. Under the “optimum DPR” scenario, median DPR demand would be set at 45 MGD, enabling a higher maximum IPR demand of up to 105 MGD. In a lower DPR demand configuration (“minimum DPR”), median DPR demand would be reduced further to 35 MGD, effectively removing constraints on IPR demand and aligning IPR operations with the baseline conditions.

Table 8-3: Balancing DPR and IPR Demands[1]

	Baseline	HIGH TWA	MED TWA	LOW TWA
	RWA at Weymouth via Satellite Facility (Scenario 1A)	Highest Possible TWA via Satellite Facility (Scenario 3A)	Medium TWA via Satellite Facility (Scenario 3C)	Lowest Required TWA via Satellite Facility (Scenario 3B)
Seasonal Maximum RWA/TWA Flow	60 MGD	100 MGD	60 MGD	50 MGD
Median RWA/TWA Flow	45 MGD	75 MGD	45 MGD	35 MGD
Maximum IPR Flow	105 MGD	75 MGD	105 MGD	115 MGD
Baseline/Relative Capital Cost	$10.1B	-12%	-14%	-14%
Baseline/Relative O&M Cost	$310M	+6%	-3%	-3%
Baseline/Relative Unit Cost	$5,560/AF	-3%	-7%	-9%

Notes: (1) 150 MGD PWSC; Online factor is 93%; DPR connection for Scenario 3 is SLF. IPR termination point for Scenarios 3A-HIGH and 3C is Santa Fe Spreading Grounds. Scenario 3B terminates at Canyon Spreading Grounds. Relative cost value assesses the difference compared to Scenario 1A (PWSC Baseline).

These demand tradeoffs illustrate the ability to strategically balance DPR and IPR applications to meet system objectives, while maintaining operational flexibility and reliability across varying demand conditions. The ROM cost estimates (shown in Table 8-3) indicate that substantial life-cycle cost savings relative to the baseline scenario could be achieved even when TWA is not implemented at maximum capacity.

8.4 Tradeoffs in Conveyance System Sizing

When evaluating options for reducing the backbone pipeline size under TWA implementation, both 48-inch-diameter and 54-inch-diameter configurations were analyzed to assess tradeoffs between capital and life-cycle costs. Although using the 48-inch-diameter pipeline would be an opportunity for modest upfront capital cost savings, this benefit would be offset by substantially higher long-term energy consumption because of increased hydraulic losses and pumping requirements, as shown in Table 8-4. Therefore, the life-cycle cost performance of the smaller diameter pipeline would be less favorable.

In contrast, maintaining a 54-inch-diameter backbone pipeline would provide a more balanced and cost-effective solution compared to smaller diameters, by reducing annual energy expenditures while still achieving meaningful capital cost savings relative to larger baseline configurations. In addition to improved energy efficiency, the 54-inch-diameter pipeline would offer enhanced operational flexibility compared to smaller diameters, including greater capacity to accommodate future service connections, demand variability, and potential system expansions. This added flexibility would support long-term system resilience and adaptability, making the 54-inch-diameter option the more robust and sustainable choice compared to 48-inch diameter, from both economic and operational perspectives.

Table 8-4: Tradeoffs in Conveyance System Sizing[1]

Evaluating Factors	Scenario 4A-HIGH-Single Pipe	
	54” Pipeline to Santa Fe Spreading Grounds	48” Pipeline to Santa Fe Spreading Grounds
Seasonal Peak Flow Velocity	6 feet/second	8 feet/second
Benefits	Additional flexibility and lower power cost	Lower capital cost
Challenges	Higher capital costs	Limited opportunity to add users and higher power costs
Relative Capital Cost (compared to PWSC baseline: $10.1B)	-13%	-16%
Relative O&M Cost (compared to PWSC Baseline: $310M)	-10%	-3%
Relative Unit Cost (compared to PWSC Baseline: $5,560/AF)	-10%	-10%

Notes: 1. 150 MGD PWSC; Default DPR at AWPF; Single pipeline serving DPR and IPR, Central Pool TWA; 100 MGD DPR seasonal flow; Relative cost value assesses the difference compared to Scenario 1A (PWSC Baseline).

8.5 Engineered Storage Buffer for TWA Operational Support

Incorporating an engineered buffer would provide substantial operational and regulatory advantages for TWA implementation. Engineered storage buffers would provide additional system response time, a key advantage as identified in California DPR regulations, thereby enhancing reliability and risk management. Within the Metropolitan system, three potential existing engineered storage options were identified: Palos Verdes Reservoir, Garvey Reservoir, and the Weymouth Finished Water Reservoir. The comparative results of the evaluation for these engineered buffer options are summarized in Table 8-5.

The Palos Verdes Reservoir currently has limited usable storage and service area, constrained by operational conditions and hydraulics. However, once the SLF PCCP and the west-side drought projects are completed, PVR could serve as the engineered storage buffer for TWA via SLF and could potentially allow water deliveries northbound to the Jensen service area for drought mitigation.

Garvey Reservoir could serve as an engineered storage buffer for TWA implementation at the Middle Feeder, which in turn would necessitate maintaining a larger backbone pipeline to convey purified water to that location. In addition, options for managing treatment residuals, including RO concentrate, could be limited in the vicinity of the Middle Feeder. However, Garvey Reservoir could be fully utilized to also serve the large downstream demands in the Central Pool, potentially all the way to the Jensen service area for drought mitigation, once its current rehabilitation projects and the west-side drought projects are completed.

Alternatively, implementing TWA at Weymouth would allow the Weymouth Finished Water Reservoir to serve as an engineered buffer for TWA. The TWA demands in the Upper Feeder, Middle Feeder and Orange County Feeder could potentially be served from this location. However, given its current operational configuration and with reservoir water surface elevation governed by distribution system hydraulics, the usable storage volume is constrained and is expected to provide only limited buffering capacity.

Table 8-5: Evaluation of Options for Utilizing Existing Engineered Storage Buffers

Evaluating Factors	With Existing Engineered Storage Buffers		With Limited Engineered Storage Buffers
	Middle Feeder (Middle Feeder with Garvey Reservoir Scenario 3A-HIGH-MF)	Weymouth Finished Water Reservoir Scenario 2	Second Lower Feeder (No Reservoir Scenario 3A-HIGH-SLF)
Nearest Pipeline/Feeder	Middle Feeder	New DPR Pipeline	Second Lower Feeder
Benefits	• Largest storage buffer for DPR demand management	• Potential to meet additional demands in Metropolitan's Central Pool and to supplement Weymouth Plant production flows	• Lower lifecycle costs • Eliminates need for additional tanks and simplifies design
Challenges	• Second pass RO (nitrate concentrate management is a challenge) • Maximum DPR demand is limited based on the Middle Feeder design capacity	• Would require construction of approximately 10 miles of new pipeline • Limited ability to handle flow variations. Would require a detailed review of the flows and operations	• The response time requirement would need to be met by other strategies, including engineered storage at TWA pump station
Maximum Seasonal Peak TWA Flow	100 MGD	60 MGD	100 MGD
Median TWA Flow	75 MGD	40 MGD	75 MGD
Relative Capital Cost (compared to baseline: $10.1B)	-1%	+3%	-12%
Relative O&M Cost (compared to Baseline: $310M)	+10%	+6%	+6%
Relative Unit Cost (compared to Baseline: $5,560/AF)	+5%	+8%	-3%

Note: 1. Relative cost value assesses the difference compared to Scenario 1A (PWSC Baseline).

Section 9: Additional Study Needs to Advance DPR Planning

Based on findings of this study and considerations from Metropolitan's *Roadmap for Direct Potable Reuse: Considerations for Implementing DPR through the Pure Water Southern California* (2024), additional technical studies on the following subjects are recommended to be conducted to refine Metropolitan's DPR implementation approach.

9.1 Temperature Impacts

A temperature study is recommended to evaluate the impact of advanced treated water on delivered water temperature aesthetics, along with the temperature impacts on disinfectant residual stability and nitrification over the full range of blend ratios in each feeder.

9.2 Compliance with Nitrate Target

Metropolitan's Antidegradation Policy imposes strict limits for nitrate and boron that would require additional treatment beyond the IPR or DPR treatment trains identified in this TM to target these parameters. In tandem with the evaluation of TWA demands, an assessment of whether these demands currently rely on blending with imported water to achieve compliance with nitrate or boron in downstream systems is recommended. In addition, further assessment of Metropolitan's Antidegradation Policy is recommended, including a sensitivity analysis of the costs and benefits for a wider range of purified water concentrations for nitrate and boron. This is expected to require engagement with Metropolitan's member agencies to determine acceptable boron and nitrate concentrations for TWA alternatives. Finally, cost-effective strategies for meeting nitrate requirements must be developed. These alternative approaches should be compared.

9.3 Operational Modeling Update

PWSC provides Metropolitan with an important new water supply that will further diversify its supply portfolio and provide resiliency. Keeping the product water produced by PWSC within Metropolitan's existing business model (drinking water versus IPR for groundwater recharge) would carry less risk to Metropolitan and allow for greater control of all aspects of PWSC.

The operational modeling performed for this analysis identified the online factors and median blend percentage. The modeling effort could be expanded to consider any differences in revenue for DPR and IPR for the overall cost assessment.

Similar to Metropolitan's prior investment in being able to nimbly switch between SWP and CRA supplies, a follow-up study and associated operational modeling that prioritizes DPR demands should also assess the potential for improving hydraulics, reducing water age, and enhancing Metropolitan's ability to move water from the identified TWA connection points to other areas of the Metropolitan system. This should include potential identification of infrastructure investment in the regional system to improve the operational connectivity, maximize flexibility, and enhance reliability with a new DPR supply.

9.4 DPR Treatment Alternatives and Optimization

A DPR demonstration facility is currently in design to test the DPR default train as well as alternative treatment trains, to be considered for full-scale implementation, aligning with the scenarios presented in this TM. The study would demonstrate the efficacy of both the default and alternative

DPR treatment trains for regulatory acceptance. Ozone and BAC treatment provide enhanced water quality that has the potential to offer significant optimization of the AWPF. This is likely to reduce the capital and O&M costs of the default DPR treatment train for Scenario 4.

9.5 Corrosion and Metal Mobilization

As part of the demonstration testing, a pipe loop study has been planned to evaluate the impacts on conveyance lines from variable blend ratios of stabilized advanced treated water to finished water from the Metropolitan plants. Harvested pipe from older pipelines could be included for this analysis to assess the potential release of accumulated scale material. This study intends to evaluate potential impacts on new and existing pipelines that will receive services from PWSC.

9.6 Blending

A water quality integration study will be performed for the introduction of advanced treated water into the distribution system with a focus on trace organic compounds and emerging compounds of concern at various blend ratios in each feeder. Water quality parameters expected to be different between the advanced treated water and the WTP finished water will be assessed to identify potential integration impacts into the distribution system. Some of these parameters include disinfection byproducts (DBPs), contaminants of emerging concern (CECs), and any other parameters with values in the advanced treated water that exceed those in the WTP finished water.

9.7 Chemical Peak Dilution

A chemical peak dilution study can assess additional mixing and/or equalization requirements in the wastewater treatment plant, AWPF, and any DPR satellite treatment to comply with chemical peak dilution requirements in the DPR regulations. This assessment may impact the infrastructure requirements and costs, and identifying and comparing any additional costs associated with meeting chemical peak dilution requirements for each scenario carried forward are recommended.

9.8 Public Outreach and Taste-Testing Study

As Metropolitan evaluates DPR implementation strategies for PWSC, the program would benefit from additional DPR-focused outreach and public acceptance evaluation conducted in coordination with DPR demonstration testing. This effort would provide an opportunity to assess public awareness, questions, concerns, and information needs related to DPR. Outreach conducted during operation of the DPR Demonstration Facility should build on PWSC's existing public engagement foundation and include opportunities to learn about DPR through tours, presentations, community events, multilingual materials, and various media channels.

Previous public opinion research conducted for PWSC in 2024 indicated that support for the program and DPR applications increases when clearer information about the program benefits and purification process is provided. This finding suggests that future outreach should move beyond broad and technical descriptions of potable reuse and provide plain-language explanations of what is being considered, why it is being evaluated, how treatment and monitoring would work, and what safeguards and regulatory requirements would be applied.

As DPR is developed and studied, the inclusion of DPR-focused tour elements could help visitors understand how DPR fits into the overall PWSC program and purification process, including the differences between RWA and TWA, treatment trains, monitoring, and regulatory oversight. Visual in-person engagement would help connect technical information to public priorities, including safe drinking water, reliability, transparency, and confidence in the process.

Additionally, a purified water tasting station could be evaluated as part of this study. A smaller-scale DPR tasting facility is currently being considered at the DPR Demonstration Facility. The DPR treated water could potentially be distributed to the PVR for testing and public outreach. A tasting station would make the DPR experience more tangible, allow visitors to taste the water after learning how the purification process works, and provide real-time feedback on whether the tour and messaging are helping build confidence.

Public acceptance is a critical consideration for water reuse. Continued outreach, education and opportunities for public feedback will be important to support transparent decision-making as PWSC implementation strategies are further evaluated.

9.9 Hydraulic Modeling

To better understand the variations in water quality in the distribution system and operation limitations of preferred DPR implementation scenarios, it is recommended that hydraulic modeling be conducted in tandem with the operational modeling. This would allow for evaluation of the range of actual blend ratios of advanced treated water and finished water from WTPs under different demand and seasonal conditions.

Hydraulic modeling is also recommended for preferred DPR scenarios to evaluate the impacts of diversion on the distribution system. This assessment would identify pressure fluctuations, flow reversal, impact on fire flow demand, and other elements that can influence the design of the storage facilities, the TWA or the RWA pump station, and other PWSC needs.

The AWPF is designed to operate at a consistent flow capacity. Thus, it is expected that seasonal variations in drinking water demand in the feeders would be addressed by increasing or decreasing the contribution of flow from the Diemer or the Weymouth plants. This seasonal variation in source water blending in the distribution system would lead to seasonal variations in water quality aesthetics because of the resulting hardness, total dissolved solids (TDS), and temperature of the blend would be changing based on the ratios of CRA and SWP flows at the conventional plants. However, since some Metropolitan customers are already used to receiving varying water quality throughout the year based on different blends of CRA and SWP supplies, the seasonal change may not be noticeable. Additionally, the TWA water would be lower in TDS and hardness relative to the existing supplies, which customers may find more desirable.

The location of the purified water connection points into the distribution system, in conjunction with the varying demand of other water sources, can also have significant impacts. At the extreme end, some customers would only receive purified water, while others would only receive other water sources (i.e., Diemer or Weymouth treated water). Those customers in-between would receive a blend of the two, but the water quality blend itself would vary seasonally. Thus, the hardness, TDS, and temperature of the drinking water that customers receive would vary based on their proximity to the connection points of the purified water (Stantec et al., 2024).

9.10 Off-Spec Flow and Treatment Residuals Management

Off-spec water should be automatically diverted based on triggers for pathogens like Giardia and Cryptosporidium. Since protozoa triggers are similar for both DPR and IPR, a potential failure causing protozoa LRVs to fall below 10 logs would make diversion to IPR unreliable for off-spec advanced treated water. There is also regulatory uncertainty as to how DDW would enforce sending DPR off-spec water to IPR end users if the off-spec event is caused by a real-time nitrate or total organic carbon exceedance. The AWPF and a potential satellite treatment facility should have the capability to divert off-spec water to waste; this process will be coordinated with the Los Angeles County Sanitation Districts and Warren Facility staff.

In addition, a key challenge associated with the satellite facilities is the management and disposal of treatment residuals, particularly the concentrate from the two-pass RO. Effective handling of these residual streams is critical to ensure regulatory compliance and overall system feasibility. Targeted technical studies should be conducted to evaluate viable residual management strategies.

Coordination efforts will include assessment of sewer capacities near potential sites for satellite DPR treatment facilities and process to manage off-spec water for discharge purposes.

9.11 Post-Treatment Stabilization

Matching pH and maintaining appropriate Langelier Saturation Index and Calcium Carbonate Precipitation Potential levels in the distribution system are critical for DPR implementation, and lower alkalinity is more suitable for TWA applications. Thus, various post-treatment stabilization alternatives should be assessed for Scenarios 2, 3, and 4, including lime + CO_2, sodium hydroxide + calcium chloride, and combinations thereof, and cost and water quality implications should be analyzed.

9.12 Water Age and Water Quality Strategy Development

Production of DPR at the AWPF and introducing advanced treated water into existing system feeders offers new entry point locations within the Metropolitan system. As part of the operational and hydraulic modeling to evaluate downstream connections, including system modifications or investments that might be needed (e.g., pump stations, interties, pipeline reinforcement), alternatives should be developed to reduce water age and improve water quality by moving various source waters across the system to increase supply diversity and reduce the potential for nitrification.

9.13 Satellite Facility Siting and Planning

Except for Scenario 4, all other DPR scenarios require the construction of satellite treatment facilities. A detailed siting and planning study is required. This evaluation should consider potential land acquisition, availability of vacant parcel with sufficient space for DPR treatment processes, O&M facilities, and ancillary equipment. Additionally, staffing requirements, operator certification, DPR response time, chemical peak dilution requirements, and diversion provisions must also be evaluated.

Section 10: Summary

The purpose of this TM is to evaluate potential DPR implementation scenarios, including demand projections, DPR treatment and locations, and possible DPR connection points to Metropolitan's existing feeders, and to assess required infrastructure improvements, perform a cost analysis, identify potential benefits, and recommend additional technical studies.

10.1 Potential DPR Implementation Scenarios

The TM outlines four primary DPR implementation scenarios with sub-options, based on potential connection points and infrastructure configurations. These scenarios are conceptual and will be further refined through the upcoming DPR demonstration testing, as well as additional engineering, water quality, and operational inputs.

Each scenario was evaluated for hydraulic feasibility, operational flexibility, infrastructure requirements, and its potential to meet DPR demand targets.

- **Scenario 1 – Weymouth RWA:** Introduce purified water upstream of the Weymouth plant in the vicinity of the Weymouth Raw Water Junction Structure. This requires a satellite treatment facility at or near Weymouth.
  - **Scenario 1A:** Augment 60 MGD maximum and 30 MGD median flow using the existing Azusa pipeline and a new DPR pipeline. Scenario 1A meets IPR demands and achieves a 95% online factor.
  - **Scenario 1B:** Augment 60 MGD maximum and 40 MGD median flow using a new DPR pipeline. Scenario 1B meets IPR demands and achieves a 92% online factor.
  - **Scenario 1C:** Augment 60 MGD maximum and 30 MGD median flow using the existing Azusa pipeline. Scenario 1C meets IPR demands and achieves a 100% online factor.
- **Scenario 2 – Weymouth TWA:** Introduces 60 MGD maximum and 40 MGD median of purified water directly into the Weymouth Finished Water Reservoir to support TWA and supplement Weymouth plant output into various feeders. This requires a satellite treatment facility and a DPR pipeline. Scenario 2 meets IPR demands and achieves a 92% online factor.
- **Scenario 3 – Central Pool TWA using Satellite Treatment:** Deliver purified water from the backbone pipeline to a satellite facility for treatment and connect to a feeder in the Central Pool (MF or SLF) for TWA.
  - **Scenario 3A- High TWA at MF**: Deliver 100 MGD maximum and 75 MGD median flow to MF, with storage/buffer at Garvey Reservoir for MF connections. IPR demands are limited to 75 MGD, and an online factor of 93% is achieved.
  - **Scenario 3A- High TWA at SLF**: Deliver 100 MGD maximum and 75 MGD median flow to SLF. IPR demands are limited to 75 MGD, and an online factor of 93% is achieved.
  - **Scenario 3B- Low TWA at SLF**: Deliver 50 maximum and 35 MGD median flow facility to SLF with two sub-options to address compliance with nitrate target.
    - **3B-SLF-2N**: Meeting the nitrate target of 0.9 mg/L by treatment and blending. IPR demands are met, and an online factor of 94% is achieved.
    - **3B-SLF-0.9N**: Meeting the nitrate target of 0.9 mg/L by treatment only. IPR demands are met, and an online factor of 94% is achieved.

- **Scenario 3C- Medium TWA at SLF**: Deliver 60 MGD maximum and 45 MGD median flow to SLF. IPR demands are limited to 105 MGD, and an online factor of 92% is achieved.

- **Scenario 4 – Central Pool TWA using Treatment at AWPF:** Deliver advanced treated water to SLF from the AWPF. All treatment would take place at AWPF.
  - **Scenario 4A**: Provide 100 MGD maximum and 75 MGD median flow to SLF. IPR demands are limited to 75 MGD, and an online factor of 93% is achieved.
    - **4A- High TWA using Single Pipeline with Default DPR Treatment**: Treatment and conveyance will be consolidated to serve both IPR and DPR demands. The default DPR train and a single pipeline will be utilized. This option provides the most favorable operational framework and cost savings.
    - **4A- High TWA using Separate Pipelines with Alternative DPR Treatment:** The alternative train will be utilized to treat the DPR demands. Separate pipelines will be used for DPR and IPR deliveries.
  - **Scenarios 4B- Low TWA using Separate Pipelines with Alternative DPR Treatment**: Deliver 50 MGD maximum and 35 MGD median flow from the AWPF to SLF. Use an alternative treatment train for DPR treatment at AWPF. Deliver IPR and DPR demands using separate pipelines. Scenario 4B meets IPR demands and achieves an online factor of 94%.
  - **Scenario 4C- Medium TWA using Separate Pipelines with Alternative DPR Treatment:** Deliver 60 MGD maximum and 45 MGD median flow from the AWPF to SLF. Use an alternative treatment train for DPR treatment at AWPF. Deliver IPR and DPR demands using separate pipelines. Scenario 4C limits the IPR demands to 105 MGD and achieves an online factor of 92%.

10.2 Operational Considerations and Challenges

Each of the DPR implementation scenarios brings a unique set of treatment facility operational challenges:

- Operating a satellite facility at Weymouth Plant and in the vicinity of MF for 1C (Scenarios 1 and 2)
- Operating a satellite facility in the vicinity of SLF or MF (Scenario 3)
- Operating multiple trains within AWPF (Scenario 4A-Alt, 4B and 4C)

TWA Scenarios 3 and 4 involve the introduction of advanced treated water into Metropolitan's Feeders, which could potentially increase water age, nitrification risk, and related challenges. Maintaining the water quality in the water distribution system is a challenge that will be further evaluated.

Meeting the boron target (0.57 mg/L) and nitrate target (0.9 or 2 mg/L) in the advanced treated water requires additional treatment steps, such as two-pass RO with pH adjustment, resulting in long-term O&M needs and higher life-cycle cost.

10.3 DPR Implementation Strategy Assessment

Table 10-1 provides a summary of the required treatment and conveyance infrastructure, rough-order-of-magnitude lifecycle costs, and potential implementation challenges for each scenario.

The following summarizes the key elements of the DPR assessment:

- **Maximizing DPR through TWA**: The maximum achievable DPR via TWA is estimated at 75 MGD (median) and 100 MGD (seasonal peak), representing the upper operational capacity under current system constraints.
- **Reducing Conveyance Pipeline Size and Length**: The assessment identified opportunities to reduce conveyance pipeline size and/or length and pumping costs. Several DPR implementation scenarios require a satellite facility, which would increase ongoing operations and maintenance requirements. In other cases, a single default DPR train at the AWPF and a single pipeline for meeting TWA and IPR demands provides the most favorable operational framework and cost efficiency. Although separate DPR treatment trains and dedicated pipelines were evaluated, this configuration would add substantial additional assets and increase the lifecycle costs. One of the key trade-offs of reducing the conveyance pipeline size is the decreased flexibility to accommodate future demands or system expansions.
- **Balancing DPR and IPR Demands**: Balancing the DPR and IPR demands provides the most effective year-round utilization of purified water, achieving significant cost reductions (relative to the baseline) while meeting the target 92% online factor. The ROM cost estimates indicate that substantial life-cycle cost savings could be achieved even when TWA is not implemented at maximum capacity.
- **Retaining Conveyance System Flexibility**: If the TWA connection is made at the SLF near the AWPF, the backbone conveyance could be optimized by reducing both pipe size and length, resulting in reduced capital costs. A minimum diameter of 54 inches is maintained for pipelines delivering IPR demands. It should be noted that reducing the pipe size below 54 inches would significantly increase the O&M costs and limit Metropolitan's ability to handle greater demands/flows in the future or to integrate with other potential projects and initiatives.
- **Optimizing TWA Connection Point**: Utilizing the SLF or MF is essential for achieving higher DPR capacity and maintaining the desired online factor. However, introducing TWA in the SLF or MF may increase maintenance requirements due to water age concerns.
- **Addressing Water Quality Challenges**: This study indicates that DPR implementation is feasible; the currently planned DPR testing is crucial for understanding the water quality challenges, and the initial stage of PWSC can be implemented without any delay.
- **Identifying Key Areas Requiring Additional Investigation**: Further technical studies on water quality, public acceptance, hydraulics, and engineering would be recommended. The lifecycle costs were developed based on several assumptions, including potential treatment steps in the alternative DPR train. The DPR demonstration facility currently in design will play a critical role in resolving these issues and guiding future decision-making.

Table 10-1: Summary of the Required Treatment and Conveyance Infrastructure, Rough-Order-of-Magnitude Total Life-Cycle Costs, and Potential Implementation Challenges for Each Scenario

DPR Type	Scenario	Identifier	DPR Design Flow[1], MGD	IPR Design Flow, MGD	DPR Connection	IPR Termination Point	Pipelines	Treatment	DPR Purified Water Nitrate mg/L	Pump Station (PS)	ROM Capital Cost ($M)	Relative Capital Cost Percentage Difference(%)	Annual O&M Cost ($M)	Relative O&M Percentage Difference (%)	Online Factor	$/AF[4]	Unit Percentage Difference (%)[5]	Challenges
Weymouth RWA	1A	1A-LOW-WEY-IPR TRAIN & ALT DPR-2N	60 (Max) 30 (Median)	120 MGD (Max)	Near Weymouth Raw Water Junction Structure[2]	Canyon Spreading Grounds (Canyon)	• Backbone Pipeline • Azusa Pipeline (30 MGD) • DPR Pipeline (60 MGD)	• IPR Train at AWPF • RWA Alternative Train in Satellite near Weymouth	2	• AWPF PS • Whittier Narrows PS • Santa Fe PS • Canyon & Big Dalton PS • DPR PS	$10,100	Baseline	$310	Baseline	95%	$5,560	Baseline	• Multiple advanced water treatment (AWT) locations (AWPF and Satellite) • Backbone and DPR pipelines with multiple pump stations • Requires a partial second pass RO and blending to meet the nitrate and boron targets • Potential blending challenges due to limited raw water supplies from CRA and SWP allocations
Weymouth RWA	1B	1B-LOW-WEY-IPR TRAIN & ALT DPR-2N	60 (Max) 40 (Median)	105 MGD (Max)	Near Weymouth Raw Water Junction Structure[2]	Santa Fe Spreading Grounds (SFSG)	• Backbone Pipeline • DPR Pipeline	• IPR Train at AWPF • RWA Alternative Train in Satellite near Weymouth	2	• AWPF PS • Whittier Narrows PS • Santa Fe PS • DPR PS	$9,700	-4%	$300	-3%	92%	$5,530	-1%	• Similar to challenges listed in Scenario 1A-Weymouth RWA-Baseline
Weymouth RWA	1C	1C-LOW-WEY-IPR TRAIN & ALT DPR-0.9N	60 (Max) 30 (Median)	120 MGD (Max)	Near Weymouth Raw Water Junction Structure[2]	Canyon Spreading Grounds (Canyon)	• Backbone Pipeline • Azusa Pipeline (30 MGD) • DPR Pipeline (60 MGD)	• IPR Train at AWPF • RWA Alternative Train in Satellite near Weymouth • TWA Alternative Train in Satellite near MF	0.9	• AWPF PS • Whittier Narrows PS • Santa Fe PS • Canyon & Big Dalton PS	$10,500	4%	$300	-3%	100%	$5,360	-4%	• Similar to challenges listed in Scenario 1A-Weymouth RWA-Baseline
Weymouth TWA	2	2-LOW-WEY RSVR-IPR TRAIN & ALT DPR-2N	60 (Max) 40 (Median)	105 MGD (Max)	Weymouth Finished Water Reservoir	SFSG	• Backbone Pipeline • DPR Pipeline	• IPR Train at AWPF • TWA Alternative Train in Satellite near Weymouth	0.9	• AWPF PS • Whittier Narrows PS • Santa Fe PS • DPR PS	$10,400	3%	$330	6%	92%	$5,990	8%	• Multiple AWT locations (AWPF and Satellite) and multiple pipelines • Requires RO at AWPF to meet boron target and at the Satellite Facility to meet the nitrate target
Central Pool TWA using Satellite DPR Facility	3A-MF	3A-HIGH-MF-IPR TRAIN & ALT DPR-0.9N	100 (Max) 75 (Median)	75 MGD (Max)	MF[3]	SFSG	• Backbone Pipeline • DPR Pipeline	• IPR Train at AWPF • TWA Alternative Train in Satellite near MF	0.9	• AWPF PS • Whittier Narrows PS • MF PS	$10,000	-1%	$340	10%	93%	$5,840	5%	• IPR demands are limited to 75 MGD • Multiple AWT locations (AWPF and Satellite) • Multiple pipelines • Nitrification, water age management, and maintaining ideal water quality • Requires RO at AWPF to meet boron target and at the Satellite Facility to meet the nitrate target
Central Pool TWA using Satellite DPR Facility	3A-SLF	3A-HIGH-SLF-IPR TRAIN & ALT DPR-0.9N	100 (Max) 75 (Median)	75 MGD (Max)	SLF	SFSG	• Backbone Pipeline • DPR Pipeline	• IPR Train at AWPF • TWA Alternative Train in Satellite near SLF	0.9	• AWPF PS • Whittier Narrows PS • SLF PS	$8,900	-12%	$330	6%	93%	$5,380	-3%	• Similar to challenges listed in Scenario 3A HIGH-MF
Central Pool TWA using Satellite DPR Facility	3B-0.9N	3B-LOW-SLF-IPR TRAIN & ALT DPR-0.9N	50 (Max) 35 (Median)	115 MGD (Max)	SLF	Canyon	• Backbone Pipeline • DPR Pipeline	• IPR Train at AWPF • TWA Alternative Train in Satellite near SLF	0.9	• AWPF PS • Whittier Narrows PS • Santa Fe PS • SLF PS	$8,700	-14%	$300	-3%	94%	$5,050	-9%	• Similar to challenges listed in Scenario 3A HIGH-MF • Requires RO at AWPF to meet boron target and at the Satellite Facility to meet the nitrate target
Central Pool TWA using Satellite DPR Facility	3B-2N	3B-LOW-SLF-IPR TRAIN & ALT DPR-2N	50 (Max) 35 (Median)	115 MGD (Max)	SLF	Canyon	• Backbone Pipeline • DPR Pipeline	• IPR Train at AWPF • TWA Alternative Train in Satellite near SLF	2	• AWPF PS • Whittier Narrows PS • Santa Fe PS • SLF PS	$8,700	-14%	$280	-10%	94%	$4,940	-11%	• Similar to challenges listed in Scenario 3A HIGH-MF, except for RO at the Satellite Facility to meet the nitrate target

DPR Type	Scenario	Identifier	DPR Design Flow[1], MGD	IPR Design Flow, MGD	DPR Connection	IPR Termination Point	Pipelines	Treatment	DPR Purified Water Nitrate mg/L	Pump Station (PS)	ROM Capital Cost ($M)	Relative Capital Cost Percentage Difference(%)	Annual O&M Cost ($M)	Relative O&M Percentage Difference (%)	Online Factor	$/AF[4]	Unit Percentage Difference (%)[5]	Challenges
	3C	3C-MED-SLF-IPR TRAIN & ALT DPR-0.9N	60 (Max) 45 (Median)	105 MGD (Max)	SLF	SFSG	• Backbone Pipeline • DPR Pipeline	• IPR Train at AWPF • TWA Alternative Train in Satellite near SLF	0.9	• AWPF PS • Whittier Narrows PS • SLF PS	$8,700	-14%	$300	-3%	92%	$5,170	-7%	• IPR demands are limited to 105 MGD • Similar to challenges listed in Scenario 3A HIGH-MF
Central Pool TWA using AWPF DPR Facility	4A-Default DPR	4A-HIGH-SLF-SINGLE PIPE-SINGLE DFLT DPR TRAIN-0.9N	100 (Max) 75 (Median)	75 MGD (Max)	SLF	SFSG	• Single pipeline serving DPR and IPR demands	• Default DPR Train at AWPF	0.9	• AWPF PS • Whittier Narrows PS • SLF PS	$8,800	-13%	$280	-10%	93%	$4,990	-10%	• IPR demands are limited to 75 MGD • Challenge of maintaining ideal water quality for IPR and DPR in one conveyance system • Nitrification, water age management, and maintaining ideal water quality
	4A-Alternative DPR	4A-HIGH-SLF-DUAL PIPE-IPR & ALT DPR TRAINS-0.9N	100 (Max) 75 (Median)	75 MGD (Max)	SLF	SFSG	• Separate DPR and IPR Pipelines	• IPR Train at AWPF • TWA Alternative Train at AWPF	0.9	• AWPF PS • Whittier Narrows PS • SLF PS	$9,600	-5%	$330	6%	93%	$5,620	1%	• IPR demands are limited to 75 MGD • Multiple treatment trains dedicated to IPR and DPR • Multiple pipelines • Requires RO at AWPF to meet boron target and at the Satellite Facility to meet the nitrate target • Nitrification, water age management, and maintaining ideal water quality
	4B	4B-LOW-SLF-DUAL PIPE-IPR TRAIN & ALT DPR-0.9N	50 (Max) 35 (Median)	115 MGD (Max)	SLF	Canyon	• Separate DPR and IPR Pipelines	• IPR Train at AWPF • TWA Alternative Train at AWPF	0.9	• AWPF PS • Whittier Narrows PS • Santa Fe PS • SLF PS	$9,400	-7%	$300	-3%	94%	$5,290	-5%	• Similar to challenges listed in 4A-Alternative DPR
	4C	4C-MED-SLF-DUAL PIPE-IPR TRAIN & ALT DPR-0.9N	60 (Max) 45 (Median)	105 MGD (Max)	SLF	SFSG	• Separate DPR and IPR Pipelines	• IPR Train at AWPF • TWA Alternative Train at AWPF	0.9	• AWPF PS • Whittier Narrows PS • SLF PS	$9,000	-11%	$300	-3%	92%	$5,290	-5%	• IPR demands are limited to 105 MGD • Similar to challenges listed in 4A- Alternative DPR

[1] Potential Long Beach DPR Demand currently not included, could result in additional 19 MGD DPR capacity. [2] With potential flexibility to serve Weymouth and Diemer demands; [3] With storage in Garvey Reservoir (via Middle Feeder); [4] Based on 150 MGD DPR/IPR capacity; [5] Relative cost value assesses the difference compared to Scenario 1A (PWSC Phase 1 Baseline)

Attachment A:

ROM Cost Estimate Details

	1A -Weymouth RWA- Baseline	1B - Weymouth RWA - New Pipeline	1C - Weymouth + Diemer RWA Baseline	2-Weymouth TWA	3A-MAX-MF	3A-MAX -SLF
Capacity of Alternative	**150**	**150**	**150**	**150**	**150**	**150**
Capital Cost (February Updates)	$10,078,156,575	$9,740,903,326	$10,460,480,762	$10,360,037,274	$9,986,644,967	$8,920,884,087
Annual Payment on Capital Cost (Canyon)	$577,375,932	$558,054,749	$599,279,222	$593,524,831	$572,133,247	$511,075,981
Annual O&M	$310,208,374	$297,185,450	$301,368,195	$331,916,509	$340,961,098	$329,870,707
R&R Fund	$0	$0	$0	$0	$0	$0
Total Annual Payment						
100% Online Factor	100%	100%	100%	100%	100%	100%
Production (AFY) - Online Factor (100%)	168,033	168,033	168,033	168,033	168,033	168,033
Online Factor per February 2026 Updates	95%	92%	100%	92%	93%	93%
Production (AFY) - Online Factor (Canyon)	159,631	154,590	168,033	154,590	156,271	156,271
Dollar Per Acre-Ft Calc (w/ 100% online factor)	**$5,282**	**$5,090**	**$5,360**	**$5,507**	**$5,434**	**$5,005**
Dollar Per Acre-Ft Calc (w/ online factor)	**$5,560**	**$5,532**	**$5,360**	**$5,986**	**$5,843**	**$5,381**

	3B-MIN-SLF-0.9 NO3	3B-MIN-SLF-2 NO3	3C-OPT-SLF	4A-MAX-Single	4A-MAX-Single IPR Train/Alternative DPR-Dual Pipe-0.9N	4B-MIN-Dual-0.9-NO3	4C-OPT-Dual
Capacity of Alternative	**150**	**150**	**150**	**150**	**150**	**150**	**150**
Capital Cost (February Updates)	$8,724,963,642	$8,679,290,490	$8,674,322,569	$8,778,572,320	$9,595,588,906	$9,351,782,213	$8,979,648,667
Annual Payment on Capital Cost (Canyon)	$499,851,731	$497,235,124	$496,950,513	$502,922,964	$549,729,710	$535,762,064	$514,442,595
Annual O&M	$297,288,939	$282,427,035	$302,592,825	$276,298,397	$328,721,014	$299,720,020	$303,126,507
R&R Fund	$0	$0	$0	$0	$0	$0	$0
Total Annual Payment							
100% Online Factor	100%	100%	100%	100%	100%	100%	100%
Production (AFY) - Online Factor (100%)	168,033	168,033	168,033	168,033	168,033	168,033	168,033
Online Factor per February 2026 Updates	94%	94%	92%	93%	93%	94%	92%
Production (AFY) - Online Factor (Canyon)	157,951	157,951	154,590	156,271	156,271	157,951	154,590
Dollar Per Acre-Ft Calc (w/ 100% online factor)	**$4,744**	**$4,640**	**$4,758**	**$4,637**	**$5,228**	**$4,972**	**$4,866**
Dollar Per Acre-Ft Calc (w/ online factor)	**$5,047**	**$4,936**	**$5,172**	**$4,986**	**$5,621**	**$5,290**	**$5,289**

Scenario	ROM Capital Cost ($M)	Relative ROM CapEx	Relative Capital Cost Percentage Difference (%)	Annual O&M Cost ($M)	Relative Annual O&M	Relative O&M Percentage Difference (%)	Online Factor	$/AF (Considering Online Factor)	Relative $/AF	Relative Unit Percentage Difference (%)
1A -Weymouth RWA- Baseline	$ 10,100	Baseline	Baseline	$ 310	Baseline	Baseline	95%	$ 5,560	Baseline	Baseline
1B - Weymouth RWA - New Pipeline	$ 9,700	$ (400)	-4%	$ 300	$ (10)	-3%	92%	$ 5,530	$ (30)	-1%
1C - Weymouth + Diemer RWA Baseline	$ 10,500	$ 400	4%	$ 300	$ (10)	-3%	100%	$ 5,360	$ (200)	-4%
2A-Weymouth TWA	$ 10,400	$ 300	3%	$ 330	$ 20	6%	92%	$ 5,990	$ 430	8%
3A-MAX-MF	$ 10,000	$ (100)	-1%	$ 340	$ 30	10%	93%	$ 5,840	$ 280	5%
3A-MAX -SLF	$ 8,900	$ (1,200)	-12%	$ 330	$ 20	6%	93%	$ 5,380	$ (180)	-3%
3B-MIN-SLF-0.9 NO3	$ 8,700	$ (1,400)	-14%	$ 300	$ (10)	-3%	94%	$ 5,050	$ (510)	-9%
3B-MIN-SLF-2 NO3	$ 8,700	$ (1,400)	-14%	$ 280	$ (30)	-10%	94%	$ 4,940	$ (620)	-11%
3C-OPT-SLF	$ 8,700	$ (1,400)	-14%	$ 300	$ (10)	-3%	92%	$ 5,170	$ (390)	-7%
4A-MAX-Single	$ 8,800	$ (1,300)	-13%	$ 280	$ (30)	-10%	93%	$ 4,990	$ (570)	-10%
4A-MAX-Single IPR Train/Alternative DPR-Dual Pipe-0.9N	$ 9,600	$ (500)	-5%	$ 330	$ 20	6%	93%	$ 5,620	$ 60	1%
4B-MIN-Dual-0.9-NO3	$ 9,400	$ (700)	-7%	$ 300	$ (10)	-3%	94%	$ 5,290	$ (270)	-5%
4C-OPT-Dual	$ 9,000	$ (1,100)	-11%	$ 300	$ (10)	-3%	92%	$ 5,290	$ (270)	-5%

	Full Program 150 MGD (May 2025)	1A -Weymouth RWA- Baseline	1B - Weymouth RWA - New Pipeline	1C - Weymouth + Diemer RWA Baseline	2-Weymouth TWA	3A-MAX-MF	3A-MAX -SLF	3B-MIN-SLF-0.9 NO3	3B-MIN-SLF-2 NO3	3C-OPT-SLF	4A-MAX-Single	4A-MAX-Single IPR Train/Alternative DPR-Dual Pipe-0.9N	4B-MIN-Dual-0.9-NO3	4C-OPT-Dual
IPR Flow	90	90	90	90	90	75	75	115	115	105	75	75	115	105
DPR Flow	60	60	60	60	60	100	100	50	50	60	100	100	50	60
IPR Treatment CapEx	$ 960	$ 966	$ 966	$ 966	$ 966	$ 993	$ 993	$ 981	$ 960	$ 981	$ 15	$ 993	$ 981	$ 981
DPR Treatment CapEx (incl. Nitrate treatment)	$ 180	$ 418	$ 418	$ 506	**$ 598**	$ 784	$ 784	$ 450	$ 442	$ 516	$ 1,572	$ 783	$ 450	$ 516
Total Treatment CapEx	**$ 1,140**	**$ 1,384**	**$ 1,384**	**$ 1,472**	**$ 1,564**	**$ 1,776**	**$ 1,776**	**$ 1,430**	**$ 1,402**	**$ 1,497**	**$ 1,587**	**$ 1,776**	**$ 1,430**	**$ 1,496**
Comparative Cost Ratio	1	1.2	1.2	1.3	1.4	1.6	1.6	1.3	1.2	1.3	1.4	1.6	1.3	1.3

	Full Program 150 MGD (May 2025)	1A -Weymouth RWA- Baseline	1B - Weymouth RWA - New Pipeline	1C - Weymouth + Diemer RWA Baseline	2-Weymouth TWA	3A-MAX-MF	3A-MAX -SLF	3B-MIN-SLF-0.9 NO3	3B-MIN-SLF-2 NO3	3C-OPT-SLF	4A-MAX-Single	4A-MAX-Single IPR Train/Alternative DPR-Dual Pipe-0.9N	4B-MIN-Dual-0.9-NO3	4C-OPT-Dual
Metropolitan Cost Estimate	**$ 9,841**	**$ 10,078**	**$ 9,741**	**$ 10,460**	**$ 10,360**	**$ 9,987**	**$ 8,921**	**$ 8,725**	**$ 8,679**	**$ 8,674**	**$ 8,779**	**$ 9,596**	**$ 9,352**	**$ 8,980**
Advanced Water Treatment (AWT)	$ 1,531	$ 1,769	$ 1,769	$ 2,363	$ 1,949	$ 2,427	$ 2,427	$ 2,081	$ 2,052	$ 2,276	$ 2,366	$ 2,556	$ 2,209	$ 2,275
Site Preparation	$ 60	$ 60	$ 60	$ 60	$ 60	$ 60	$ 60	$ 60	$ 60	$ 60	$ 60	$ 60	$ 60	$ 60
Storm Drain Relocation	$ 21	$ 21	$ 21	$ 21	$ 21	$ 21	$ 21	$ 21	$ 21					
Utility Relocation	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2					
Site Grading	$ 35	$ 35	$ 35	$ 35	$ 35	$ 35	$ 35	$ 35	$ 35					
Soil/Concrete Pile Removal	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2					
Abandoned Structure Removal	$ 1	$ 1	$ 1	$ 1	$ 1	$ 1	$ 1	$ 1	$ 1					
AWT Process Facilities	$ 960	$ 966	$ 966	$ 966	$ 966	$ 993	$ 993	$ 981	$ 960	$ 981	$ 15	$ 993	$ 981	$ 981
MBR Filtrate/RO Equalization Tank/PS	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -					
MBR Filtrate	$ 4	$ 10	$ 10	$ 10	**$ 10**	**$ 10**	**$ 10**	**$ 10**	**$ 10**	**$ 10**	**$ 10**	**$ 10**	**$ 10**	**$ 10**
RO	$ 368	$ 368	$ 368	$ 368	$ 368	$ -	$ -	$ -	$ -	$ -	$ -		$ -	$ -
UV-AOP	$ 98	$ 98	$ 98	$ 98	$ 98	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Ozone/BAC/MF/RO/UV AOP (DPR at AWPF)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**	**$ -**	**$ -**	**$ 1,572**	$ 783	$ 450	$ 516
Chemicals Systems	$ 43	$ 43	$ 43	$ 43	$ 43	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**		**$ -**	**$ -**	**$ -**
Lime & Post Treatment Systems	$ 39	$ 39	$ 39	$ 39	$ 39		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Electrical and I&C	$ 161	$ 161	$ 161	$ 161	$ 161	$ 161	$ 161	$ 161	$ 161	$ 161	$ 161	$ 161	$ 161	$ 161
Backup Generators	$ 28	$ 28	$ 28	$ 28	$ 28	$ 28	$ 28	$ 28	$ 28	$ 28	$ 28	$ 28	$ 28	$ 28
Yard Piping	$ 66	$ 66	$ 66	$ 66	$ 66	$ 66	$ 66	$ 66	$ 66	$ 66	$ 66	$ 66	$ 66	$ 66
Finished Water Clearwell/PS/Surge tanks IPR/DPR	$ 154	$ 154	$ 154	$ 154	$ 154	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
BABAA Allowance (1%)		$ -	$ -	$ -										
Ancillary Facilities	$ 187	$ 181	$ 181	$ 181	$ 181	$ 181	$ 181	$ 181	$ 181	$ 181	$ 181	$ 181	$ 181	$ 181
Operations/Administration/Electrical Buildings	$ 26	$ 26	$ 26	$ 26	$ 26	$ 26	$ 26	$ 26	$ 26	$ 26	$ 26	$ 26	$ 26	$ 26
Laboratory	$ 34	$ 34	$ 34	$ 34	$ 34	$ 34	$ 34	$ 34	$ 34	$ 34	$ 34	$ 34	$ 34	$ 34
MWD Warehouse	$ 21	$ 21	$ 21	$ 21	$ 21	$ 21	$ 21	$ 21	$ 21	$ 21	$ 21	$ 21	$ 21	$ 21
MWD Maintenance Building	$ 21	$ 21	$ 21	$ 21	$ 21	$ 21	$ 21	$ 21	$ 21	$ 21	$ 21	$ 21	$ 21	$ 21
Fueling Facility	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2
Parking	$ 33	$ 33	$ 33	$ 33	$ 33	$ 33	$ 33	$ 33	$ 33	$ 33	$ 33	$ 33	$ 33	$ 33
EV facilities	$ 9	$ 9	$ 9	$ 9	$ 9	$ 9	$ 9	$ 9	$ 9	$ 9	$ 9	$ 9	$ 9	$ 9
Demonstration Garden	$ 8	$ 8	$ 8	$ 8	$ 8	$ 8	$ 8	$ 8	$ 8	$ 8	$ 8	$ 8	$ 8	$ 8

	Full Program 150 MGD (May 2025)	1A -Weymouth RWA- Baseline	1B - Weymouth RWA - New Pipeline	1C - Weymouth + Diemer RWA Baseline	2-Weymouth TWA	3A-MAX-MF	3A-MAX -SLF	3B-MIN-SLF-0.9 NO3	3B-MIN-SLF-2 NO3	3C-OPT-SLF	4A-MAX-Single	4A-MAX-Single IPR Train/Alternative DPR-Dual Pipe 0.9N	4B-MIN-Dual-0.9-NO3	4C-OPT-Dual
Amphitheater/Visitor Center	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7
Tour Galleries	$ 0.14	$ 0.14	$ 0.14	$ 0.14	$ 0.14	$ 0.14	$ 0.14	$ 0.14	$ 0.14	$ 0.14	$ 0.14	$ 0.14	$ 0.14	$ 0.14
Public Outreach Facilities	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5
Battery Storage	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7
Solar Panels	$ 8	$ 8	$ 8	$ 8	$ 8	$ 8	$ 8	$ 8	$ 8	$ 8	$ 8	$ 8	$ 8	$ 8
Street Beautification	$ 6	$ -												
Workforce Training Center	$ 15	$ 15	$ 15	$ 15	$ 15	$ 15	$ 15	$ 15	$ 15	$ 15	$ 15	$ 15	$ 15	$ 15
Power Substation	$ 129	$ 129	$ 129	$ 129	$ 129	$ 129	$ 129	$ 129	$ 129	$ 129	$ 129	$ 130	$ 129	$ 129
On-site Substation/Switchgear Facilities	$ 69	$ 69	$ 69	$ 69	$ 69	$ 69	$ 69	$ 69	$ 69	$ 69	$ 69	$ 69	$ 69	$ 69
SCE Off-site Transmission Facilities Off-site Electric Substation	$ 60	$ 60	$ 60	$ 60	$ 60	$ 60	$ 60	$ 60	$ 60	$ 60	$ 60	$ 60	$ 60	$ 60
DPR Satellite Facilities at Weymouth (from Azusa)	$ 180	**$ 418**	$ 418	$ 506	**$ 598**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**		**$ -**	**$ -**
Satellite DPR Facilities (SLF) (not included in Program Budget)	$ -	$ -	$ -	$ -	**$ -**	**$ -**	**$ 784**	**$ 450**	**$ 442**	**$ 516**	**$ -**		**$ -**	**$ -**
Satellite DPR Facilities (MF) (not included in Program Budget)	$ -	$ -	$ -	**$ 506**	**$ -**	**$ 784**		**$ -**	**$ -**	**$ -**	**$ -**		**$ -**	**$ -**
Conveyance Facilities	$ 3,854	$ 3,854	$ 3,564	$ 3,419	$ 3,760	$ 3,155	$ 2,560	$ 2,753	$ 2,753	$ 2,553	$ 2,533		$ 3,068	$ 2,799
Backbone Pipeline	$ 2,924	$ 2,924	$ 2,924	$ 2,924	$ 2,924	**$ 2,643**	**$ 2,047**	**$ 2,236**	**$ 2,236**	**$ 2,067**	**$ 2,020**	**$ 2,036**	**$ 2,250**	**$ 2,013**
Reach 1	$ 590	$ 590	$ 590	$ 590	$ 590	-	-	-	-	-	-	-	-	-
Reach 2	$ 434	$ 434	$ 434	$ 434	$ 434	-	-	-	-	-	-	-	-	-
Reach 3	$ 119	$ 119	$ 119	$ 119	$ 119	-	-	-	-	-	-	-	-	-
Reach 4	$ 254	$ 254	$ 254	$ 254	$ 254	-	-	-	-	-	-	-	-	-
Reach 5	$ 365	$ 365	$ 365	$ 365	$ 365	-	-	-	-	-	-	-	-	-
Reach 6	$ 282	$ 282	$ 282	$ 282	$ 282	-	-	-	-	-	-	-	-	-
Reach 7	$ 336	$ 336	$ 336	$ 336	$ 336	-	-	-	-	-	-	-	-	-
Reach 8a	$ 310	$ 310	$ 310	$ 310	$ 310	-	-	-	-	-	-	-	-	-
Reach 8b	$ 43	$ 43	$ 43	$ 43	$ 43	-	-	-	-	-	-	-	-	-
From Santa Fe Lateral to United Rock Pit 3	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
From Backbone to San Gabriel Coastal Spreading Grounds	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Backbone Valves and Service Connections	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Utility Relocation Allowance	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Separation Requirements Allowance	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Hazardous Soils and Groundwater Allowance	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Conveyance System Business Impacts	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Fiber Optic	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Right-of-Way/Easement Permit Costs	$ 191	$ 191	$ 191	$ 191	$ 191	$ 191	$ 191	$ 191	$ 191	$ 191	$ 191	$ 191	$ 191	$ 191
Upsized Backbone Pipeline (388.0)	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ -	$ -
Pump Stations	$ 328	$ 328	$ 204	$ 328	$ 413	$ 204	$ 204	$ 246	$ 246	$ 204	$ 204	$ 204	$ 246	$ 204
Backbone Pump Stations	$ 495	$ 495	$ 204	$ 495	$ 413	$ 322	$ 322	$ 326	$ 326	$ 295	$ 322	$ 322	$ 326	$ 295
Whittier Narrows Pump Station	$ 147	$ 147	$ 147	$ 147	$ 147	$ 147	$ 147	$ 147	$ 147	$ 147	$ 147	$ 147	$ 147	$ 147
Sante Fe Pump Station	$ 124	$ 124	$ -	$ 124	$ 124	$ -	$ -	$ 41	$ 41				$ 41	

	Full Program 150 MGD (May 2025)	1A -Weymouth RWA- Baseline	1B - Weymouth RWA - New Pipeline	1C - Weymouth + Diemer RWA Baseline	2-Weymouth TWA	3A-MAX-MF	3A-MAX -SLF	3B-MIN-SLF-0.9 NO3	3B-MIN-SLF-2 NO3	3C-OPT-SLF	4A-MAX-Single	4A-MAX-Single IPR Train/Alternative DPR-Dual Pipe 0.9N	4B-MIN-Dual-0.9-NO3	4C-OPT-Dual
SCE Substation for Whitter Narrows Pump Station	$ 58	$ 58	$ 58	$ 58	$ 58	$ 58	$ 58	$ 58	$ 58	$ 58	$ 58	$ 58	$ 58	$ 58
Weymouth RWA/TWA (not included in Program Budget)	$ -	$ -			$ 85	$ -	$ -	$ -	$ -	$ -	$ -		$ -	$ -
SLF TWA Connection Facilities/PS (not included in Program Budget)	$ -	$ -	$ -	$ -	$ -	$ -	$ 117	$ 81	$ 81	$ 90	$ 117	**$ 117**	$ 81	$ 90
MF TWA Connection Facilities/PS (not included in Program Budget)	$ -	$ -	$ -	$ -	$ -	$ 117	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
DPR Conveyance Facilities (25MGD) - Phase 1	$ 167	$ 167	$ -	$ 167	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
New 30" Pipelines (Azuza to Weymouth)	$ 148	$ 148	$ -	$ 148	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Canyon Pump Station														
Big Dalton Pump Station Rehabilitation of Existing Pipeline	$ 19	$ 19	$ -	$ 19	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Santa Fe Pump Station - Set B Pumps	$ 13	$ 13	$ 13	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ -	$ -
DPR Pump Station	$ 85	$ 85	$ 85	$ -	$ 85	$ -	$ -	$ -	$ -	$ -	$ -		$ -	$ -
DPR Pipeline	$ 315	$ 315	$ 315	$ -	$ 315	$ -	$ -	$ -	$ -	$ -	$ -	$ 367	$ 300	$ 300
Improvements at Weymouth WTP	$ 22	$ 22	$ 22	$ -	$ 22	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Recharge Facilities and Laterals Improvements	$ 553	$ 553	$ 553	$ 553	$ 553	$ 575	$ 525	$ 553	$ 553	$ 525	$ 525	$ 525	$ 553	$ 525
West Basin - SC-2 Lateral	$ 143	$ 143	$ 143	$ 143	$ 143	$ 143	$ 143	$ 143	$ 143	$ 143	$ 143	$ 143	$ 143	$ 143
Long Beach - SC-3 Lateral	$ 86	$ 86	$ 86	$ 86	$ 86	$ 86	$ 86	$ 86	$ 86	$ 86	$ 86	$ 86	$ 86	$ 86
Upper District & Three Valleys - SC-5	$ 46	$ 46	$ 46	$ 46	$ 46	$ 46	$ 46	$ 46	$ 46	$ 46	$ 46	$ 46	$ 46	$ 46
Upper District & Three Valleys - SC-6	$ 4	$ 4	$ 4	$ 4	$ 4	$ 4	$ 4	$ 4	$ 4	$ 4	$ 4	$ 4	$ 4	$ 4
Upper District & Three Valleys - SC-7	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7	$ 7
Upper District & Three Valleys - SC-8	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2
Injection Wells	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Purchase	$ 50	$ 50	$ 50	$ 50	$ 50	$ 100	$ 50	$ -	$ -	$ -	$ -	$ -	$ -	$ -
United Rock Pit No. 3	$ 50	$ 50	$ 50	$ 50	$ 50	$ 50	$ 50	$ 50	$ 50	$ 50	$ 50	$ 50	$ 50	$ 50
Vulcan Durbin	$ -	$ -	$ -	$ -	$ -	$ 50	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Vulcan Reliance No.1	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Spreading Facilities Improvements	$ 185	$ 185	$ 185	$ 185	$ 185	$ 185	$ 185	$ 185	$ 185	$ 185	$ 185	$ 185	$ 185	$ 185
United Rock Pit No. 3	$ 49	$ 49	$ 49	$ 49	$ 49	$ 49	$ 49	$ 49	$ 49	$ 49	$ 49	$ 49	$ 49	$ 49
Vulcan Durbin	$ 77	$ 77	$ 77	$ 77	$ 77	$ 77	$ 77	$ 77	$ 77	$ 77	$ 77	$ 77	$ 77	$ 77
Vulcan Reliance No.1	$ 59	$ 59	$ 59	$ 59	$ 59	$ 59	$ 59	$ 59	$ 59	$ 59	$ 59	$ 59	$ 59	$ 59
Relocation of Wells at Canyon Spreading Grounds	$ 28	$ 28	$ 28	$ 28	$ 28			$ 28	$ 28				$ 28	
Backbone Laterals by others	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1 Year Ground Water Monitoring	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2
Subtotal	$ 5,939	$ 6,176	$ 5,886	$ 6,335	$ 6,262	$ 6,157	$ 5,512	$ 5,387	$ 5,359	$ 5,354	$ 5,424	$ 5,997	$ 5,830	$ 5,599
Program Management, Engineering and Indirect Costs	$ 1,782	$ 1,782	$ 1,766	$ 1,900	$ 1,879	$ 1,847	$ 1,653	$ 1,616	$ 1,608	$ 1,606	$ 1,627	$ 1,799	$ 1,749	$ 1,680
PM Allowance (5%)	$ 297	$ 297	$ 294	$ 317	$ 313	$ 308	$ 276	$ 269	$ 268	$ 268	$ 271	$ 300	$ 291	$ 280
Engineering and Indirect Cost Allowance (25%) - AWT	$ 383	$ 383	$ 442	$ 591	$ 487	$ 607	$ 607	$ 520	$ 513	$ 569	$ 592	$ 639	$ 552	$ 569
Engineering and Indirect Cost Allowance (25%) - Conveyance & Recharge	$ 1,102	$ 1,102	$ 1,029	$ 993	$ 1,078	$ 933	$ 771	$ 827	$ 827	$ 770	$ 764	$ 860	$ 905	$ 831
Other Allowances	$ 106	$ 106	$ 105	$ 114	$ 112	$ 111	$ 99	$ 97	$ 96	$ 97	$ 98	$ 108	$ 105	$ 101
BABAA Allowance (1%)	$ 59	$ 59	$ 59	$ 63	$ 63	$ 62	$ 55	$ 54	$ 54	$ 54	$ 54	$ 60	$ 58	$ 56
Non-Allocatable Tariff Allowance (Assume 3.5%) - AWT	$ 13	$ 13	$ 15	$ 21	$ 17	$ 21	$ 21	$ 18	$ 18	$ 20	$ 21	$ 22	$ 19	$ 20
Non-Allocatable Tariff Allowance (Assume 3.0%) - Conveyance & Recharge	$ 33	$ 33	$ 31	$ 30	$ 32	$ 28	$ 23	$ 25	$ 25	$ 23	$ 23	$ 26	$ 27	$ 25
Subtotal	$ 7,826	$ 8,064	$ 7,757	$ 8,349	$ 8,253	$ 8,115	$ 7,265	$ 7,100	$ 7,063	$ 7,057	$ 7,149	$ 7,904	$ 7,683	$ 7,380
Program Contingency	$ 1,951	$ 1,951	$ 1,920	$ 2,048	$ 1,458	$ 1,080	$ 864	$ 937	$ 937	$ 871	$ 855	$ 861	$ 942	$ 853
AWT Contingency (30%)	$ 459	$ 459	$ 531	$ 709	$ 585	$ 728	$ 728	$ 624	$ 616	$ 683	$ 710	$ 767	$ 663	$ 683
Conveyance Contingency - Reaches 1&2 (30%)	$ 307	$ 307	$ 307	$ 307	$ 307	$ 277	$ 215	$ 235	$ 235	$ 217	$ 212	$ 214	$ 236	$ 211
Conveyance Contingency - remaining scope (35%)	$ 991	$ 991	$ 889	$ 838	$ 958	$ 601	$ 466	$ 509	$ 509	$ 470	$ 460	$ 463	$ 512	$ 458
Recharge Facilities & Pure Water Local Facilities (35%)	$ 194	$ 194	$ 194	$ 194	$ 194	$ 201	$ 184	$ 194	$ 194	$ 184	$ 184	$ 184	$ 194	$ 184
Soft Costs (25% Eng. and Indirect Cost + 5% PM Allowance) DPR TM Approach	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ -	$ -
Contingency (35%) DPR TM Approach	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ -	$ -
Subtotal	$ 9,777	$ 10,014	$ 9,677	$ 10,397	$ 10,296	$ 9,923	$ 8,857	$ 8,661	$ 8,615	$ 8,610	$ 8,715	$ 9,532	$ 9,288	$ 8,916
PMIS & BIM	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2	$ 2
PMIS Design and Implementation	$ 1	$ 1	$ 1	$ 1	$ 1	$ 1	$ 1	$ 1	$ 1	$ 1	$ 1	$ 1	$ 1	$ 1
BIM Design and Implementation	$ 1	$ 1	$ 1	$ 1	$ 1	$ 1	$ 1	$ 1	$ 1	$ 1	$ 1	$ 1	$ 1	$ 1
Other Shared Program Costs	$ 62	$ 62	$ 62	$ 62	$ 62	$ 62	$ 62	$ 62	$ 62	$ 62	$ 62	$ 62	$ 62	$ 62
Environmental Mitigation Measures	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20	$ 20
Community Benefits	$ 30	$ 30	$ 30	$ 30	$ 30	$ 30	$ 30	$ 30	$ 30	$ 30	$ 30	$ 30	$ 30	$ 30
AWPF Permits	$ 12	$ 12	$ 12	$ 12	$ 12	$ 12	$ 12	$ 12	$ 12	$ 12	$ 12	$ 12	$ 12	$ 12
AWT 45/75 MGD Phasing Additional Costs														
45 to 75 MGD Equipment Escalation														
45 MGD PDB Mobilization/Demobilization														
45/75 Double Commissioning														
45 to 75 MGD PDB Negative Productivity, added Safety Needs, & Additional General Site/Construction Conditions														

Source: Construction Cost Estimates - Summary View_Finance Submission 09082025.xlsx